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THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

A Linear Programming Model

Prepared by

RONCO Consulting Corporation
in collaboration with
Colorado State University
and
AGRI-BI-CON International (Pvt.) Ltd.
Analysis of Corporate Sector Constraints in Agriculture (ACSCA) Project

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FOREWORD

In January 1989, at the request of the Government of Pakistan, the United States Agency for International Development (USAID) entered into a contract with the RONCO Consulting Corporation, which collaborated with AGRI-BI-CON International (Pvt.) Limited, a Pakistani consulting firm, to carry out the **Analysis of Corporate Sector Constraints in Agriculture** (ACSCA) project. The purpose of ACSCA is to identify policy and operational constraints, capabilities and opportunities affecting the formation and growth of private sector agribusiness in Pakistan.

To assure the accomplishment of its policy and economic analysis objectives, ACSCA was designed to include the development of a quantitative model to evaluate the impact of proposed structural and economic changes in the agro-industry and farming sectors. The linear programming model envisioned had to have the capability to simulate supply and demand response resulting from a wide range of simultaneous changes in resource allocations, agro-based production and market prices within the agricultural economy. The model would be used to assess the probable economic impact of such changes as market deregulation, the privatization of state owned enterprises, provision for economic incentives to increase farm output, generate new investment in value-added commodity processing and improved technology, and the expansion of domestic and export agro-based product markets.

With these objectives in mind, the ACSCA **Pakistan Agricultural Sector Model** was developed by Colorado State University and AGRI-BI-CON economists. The model and the capability to use it has been transferred to the Economic Wing of the Ministry of Food, Agriculture and Cooperatives.

This PASM report describes the model and its capability to simulate changes occurring in the agricultural economy, including factors which impede or stimulate agribusiness activity. We feel the PASM component of ACSCA is a valuable tool for economic policy formation and analysis purposes.

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I. INTRODUCTION

In August 1989 the RONCO Consulting Corporation initiated a subcontract with Colorado State University (CSU) to have quantitative analyses provided for several RONCO studies done under the Analysis of Corporate Sector Constraints in Agriculture (ACSCA) Project. The ACSCA project consists of six case studies of individual agribusiness industries in Pakistan and a national assessment of the country's agribusiness environment. In this report, the basic model developed by the CSU team, a linear programming agricultural sector model, is presented along with the rationale for its choice and its economic content. A base run is then presented to validate the model, showing how close it simulates 1987/88. Also, several sensitivity analyses are compared with the base solution. The report ends with conclusions regarding further work.

1.1 PURPOSE OF THE QUANTITATIVE ANALYSIS

The quantitative analysis component of the ACSCA project was designed to provide a numerical assessment of selected insights derived from the individual case studies. In particular, in a number of industries a movement from public to private sector ownership appeared to be warranted, and in others there existed a variety of regulations that constrained private agribusiness growth. Therefore, the main objective was to simulate the impacts of substantial policy change as they impinge on the agricultural economy. These might take the form of changes in farm and retail prices relative to international prices, or reduced regulations on foreign investment in the local economy, just to name a few. A second important use of the model would be to provide the context for which narrower investment analyses within individual industries could be done.

Accordingly, a model was required that could incorporate policies which are deviations from a free market economy, and upon whose removal price and quantity reactions could be seen. The model needed to be flexible enough to show effects on the agricultural sector of alternative technologies, changes in availabilities and cost of different resources, or increased price responsiveness. These were the types of changes which enhanced agribusiness activity would induce. Finally, a model which simulated the externalities of agribusiness change on the agricultural sector would be preferred, as it would show the full importance of agribusiness.

1.2 THE CHOICE OF THE MODEL

Initially, the quantitative analysis was undertaken using the EAN Input-Output Working model and the PAKSIM model of the agricultural sector (Davies, 1989, and Ali, 1990). The Economic Analysis Network (EAN) Project had developed an input-output model highlighting the relationships between the agricultural and agribusiness sectors. The PAKSIM model, developed under both the EAN and ACSCA projects, was an elasticity-based simulation model which could show the effects of changing prices on quantities supplied and demanded, and the need for imports and exports. These models had several limitations for the purposes of the

RONCO project. First, they were highly aggregated, in that they specified at the national level and their coefficients summarized much information in ways which make it difficult to analyze detailed changes in investment, technologies, or policies. Likewise, it was difficult to see effects on profits and income.

Conveniently, the EAN project had also been developing marketing margin and national farm income estimates for the main crops and livestock activities in Pakistan. These provided the basic data needed to create an agricultural sector model, which is a linear programming model that met many of ACSCA's needs. (The Input-Output Model and the PAKSIM model both provide supplementary information which is not included in a sector model. The I-O model shows the extent to which changes in the farm sector affect the rest of the economy by using a business multiplier analysis, while the PAKSIM model can show more completely the impacts of all cross-elasticities between commodities and their effect on the supply and demand sides of the model, something which a sector model cannot do easily. Thus the full package of analyses would include all of these models.)

Opportunities and Risks. This choice implied both opportunities but also risks. The opportunities were that much of the data compilation was being done and would be continually refined and updated; therefore it would be easy to update and revise the model. As a sector model is a major undertaking, had it been a stand-alone project it would have been quite expensive. Having both the ACSCA and EAN projects in process, it was possible to graft a major model onto the top of those projects at moderate extra expense. The risk however was that the model might be difficult to validate in the short time available to the consultants, especially since several simulations had to be completed. While it is clear to many observers that the model's real payoff would be in the long term, where hopefully a number of institutions would use it routinely to provide quantitative support for policy analysis, it was also necessary that the model be working reasonably quickly and some simulations of agribusiness be undertaken. We believe that these conflicting demands have been met reasonably well, but the ultimate judgment will be with the reader.

Finally, it is important to recognize that another sector model exists, the Indus Basin Model Revised (IBMR), developed by the World Bank for water investment analysis. A clear question was whether to use that model or to build our own. We chose the latter for a number of reasons. The IBMR had 2,500 equations specifying the details of water flows, production scheduling and crop rotation restrictions. It was not built through to final demand, but rather focused on farm level demands without much marketing and processing activity. This resulted in a model which was large and hard to use by analysts who only had access to microcomputers; it also could not be updated easily because it was based on agroclimatic zones rather than administrative districts; and it did not easily incorporate agribusiness issues, which often can only be seen by dealing extensively in the arenas of output marketing, input supply, and trade regimes. The IBMR is at its strongest (and to be preferred to PASM) for detailed production studies. (Even so, our model has performed equally as well as the IBMR in many ways and also has some of the same tendencies found in that model). Because of the importance of that model, a comparison of results between the two efforts will be made. With more policymakers familiar

with PASM, the demand for results from IBMR may increase as well.

1.3 COMPUTER SOFTWARE AND HARDWARE REQUIREMENTS

The results reported below are based on a version of the model which runs in LP87, a modestly priced (and modestly powerful) linear programming package. To run the model in this package requires, practically, an 80486 microcomputer with at least 4 megabytes of RAM which has been configured into a RAM drive. Even with this substantial power, the model, takes over 24 hours to solve if started from a basis of slacks and artificial variables. (Many simulations can be solved from an advanced basis and thus require less time). However, the model has been converted to Hyper-LINDO and now runs in 38 minutes on a 80387 microcomputer (with a math co-processor) and in less than 6 minutes on a 486 machine. The time problem has thus been solved. The remaining problem is that there are several differences in results between the LINDO and LP87 versions of PASM, but the sources of the differences have been identified and will be corrected along with several other adjustments to be made to the model. (These adjustments are discussed further in the concluding section of the report.) We are confident that the results will be nearly identical to those reported here.

1.4 STRUCTURE OF THE REPORT

The section immediately following this introduction tackles the economic and technical structure of a sector model. Then several specific aspects of PASM are presented to give analysts and general readers the feel of the model. (The details of the model structure are given in a seven Annexes, which will be referred to as their topics are discussed in the report). The third section of the report presents the results of the base run of the model and some of the basic sensitivity analyses, in which several important constraints imposed on the model are released. The final section gives a brief comparison with the Indus Basin Model Revised results and suggests avenues for further work on PASM.

II. THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

In the following sections the concept of a sector model is first presented, and then is followed by a discussion of the Pakistan Agricultural Sector Model (PASM) developed for the ACSCA project. In brief a sector model, as developed for a number of countries mainly through World Bank funding, includes a full specification of the supply and demand sides of most major commodities in the agricultural sector. It furthermore can allow marketing, transportation, and distribution activities to be examined in detail and can also be specified to show factor supply curves -- so that the price and quantity of fertilizer, for instance, is determined endogenously within the model. The model developed here follows very closely the structure presented in Hazel and Norton, Mathematical Programming in Agriculture, and in the Turkish Agricultural Sector Model (TASM), also designed by Roger Norton among others.

2.1 ECONOMIC RELATIONSHIPS IN THE AGRICULTURAL SECTOR MODEL

2.1.1 The Supply Side of the Sector Model. The supply side of an agricultural sector model is created by constructing a series of farm budgets which vary according to factors that might importantly affect costs of production. In the process of optimizing, the model will choose those activities (budgets) which produce a given crop or livestock activity most efficiently. Typically, alternative farm budgets are included for different sizes and locations of farms, perhaps by the use of inputs such as mechanized versus animal traction, or improved versus traditional seed use. Each representative farm has a set of resources available to it, either on-farm or which can be purchased through a market at some price. These resources are usually land, fertilizer, machinery services and other inputs. They may be fixed in quantity, available in unlimited quantities at fixed prices, or an upward sloping supply curve may be built into the model, where quantities above a certain limit are only available at higher prices. This is similar in construction to a farm level linear program except that the resources are for a whole region and coefficients are aggregates of similar farm types.

2.1.2 The Demand Side of the Sector Model. On the demand side, the model has separate curves for each commodity included. Given elasticities of demand and starting quantities and prices, linear demand curves can be constructed. From them, the relationship between quantities demanded, prices and the total area at various points under the demand curve, derived from consuming each commodity at a given price, can be calculated. These latter relationships, between the area under the demand curve and quantities demanded, are used in the model. A limited number of cross-price relationships can be dealt with, but sector models do not easily include the full set of cross-price and income relationships between commodities demanded.

2.1.3 The Microeconomics of the Sector Model. A sector model then has positive values in the objective function corresponding to the consumer surplus (actually the area under the demand curve) from consuming different quantities of each food or fiber product. Exports are also given positive values. Costs of production enter the objective function as negative

values (sometimes these costs are included in the objective function directly or are priced indirectly through resource restrictions). The maximization of this function drives the markets of each commodity to an equilibrium. This is shown in Figure 1, taken from Hazel and Norton. Area A is the total consumer surplus gained when the market is in equilibrium. The payment by consumers to producers, or gross revenue, is in Area B. Gross revenues are in turn analytically separated into two areas. Area C, the area under the supply curve, is the cost of production, while Areas B-C include the producer surplus, which shows the economic rents accrued by producers.

As usual, price determines how both consumers and producers react. While price determines reactions, it is the choice of quantities which the model varies to improve the sum of producer plus consumer surplus. If production is lower than equilibrium, there is a gain in the objective function value by increasing the quantity of that commodity because the demand curve is vertically above the supply curve. Likewise, if the quantity is too large, then the supply curve (representing costs and entered into the objective function with negative signs) will be above the demand curve; in that case, there will be an improvement in the sum of producer and consumer surplus by restricting the quantity. Costs are lowered and the vertical distance between the height of the demand and supply curves is reduced. In the end, maximization will thus drive all markets to equilibrium.

In the second figure, Figure 2, a graphical representation of the supply function for the output of one commodity is shown. The supply functions are step functions, which increase with price. Each step represents the possible quantity of production at a given cost, or how much can be produced by one type of farm. One quantity may be profitable to produce at a given output price, but prices must "jump up" to justify greater quantities. Thus price may have to rise a relatively large amount to induce any response in the quantity produced rather than, as in traditional microeconomic theory, having an instantaneous response to each movement in price.

The reason the supply curve is a step function is that it is constructed using enterprise budgets rather than a function or formula. These budgets potentially differ for each crop by region, technology and size of farm. Thus small farms in the Punjab may have the most efficient production of rice, so they are the first step in the function. They have limited resources available to them, so they can only produce the quantity indicated by the horizontal distance of the first step. For production to exceed that amount, another farm-type, such as medium-sized farms in the Sind, needs to come into the solution. They comprise the second step and would only produce if there were an adequate increase in price. Thus supply response functions are not entered directly into the model but rather come from using representative farm budgets. These functions can be examined by re-solving the model with differing production levels of an individual crop forced into the solution, or by looking at the response as one price is increased relative to other prices (done by solving the dual).

The above discussion has not indicated that marketing or processing functions exist in the model. Yet production clearly occurs at the farm and final consumption is at retail. These activities are tied together in a sector model through marketing margins (the price at retail less

Figure 1. THE GEOMETRY OF THE OBJECTIVE FUNCTION MODELING MARKET EQUILIBRIUM

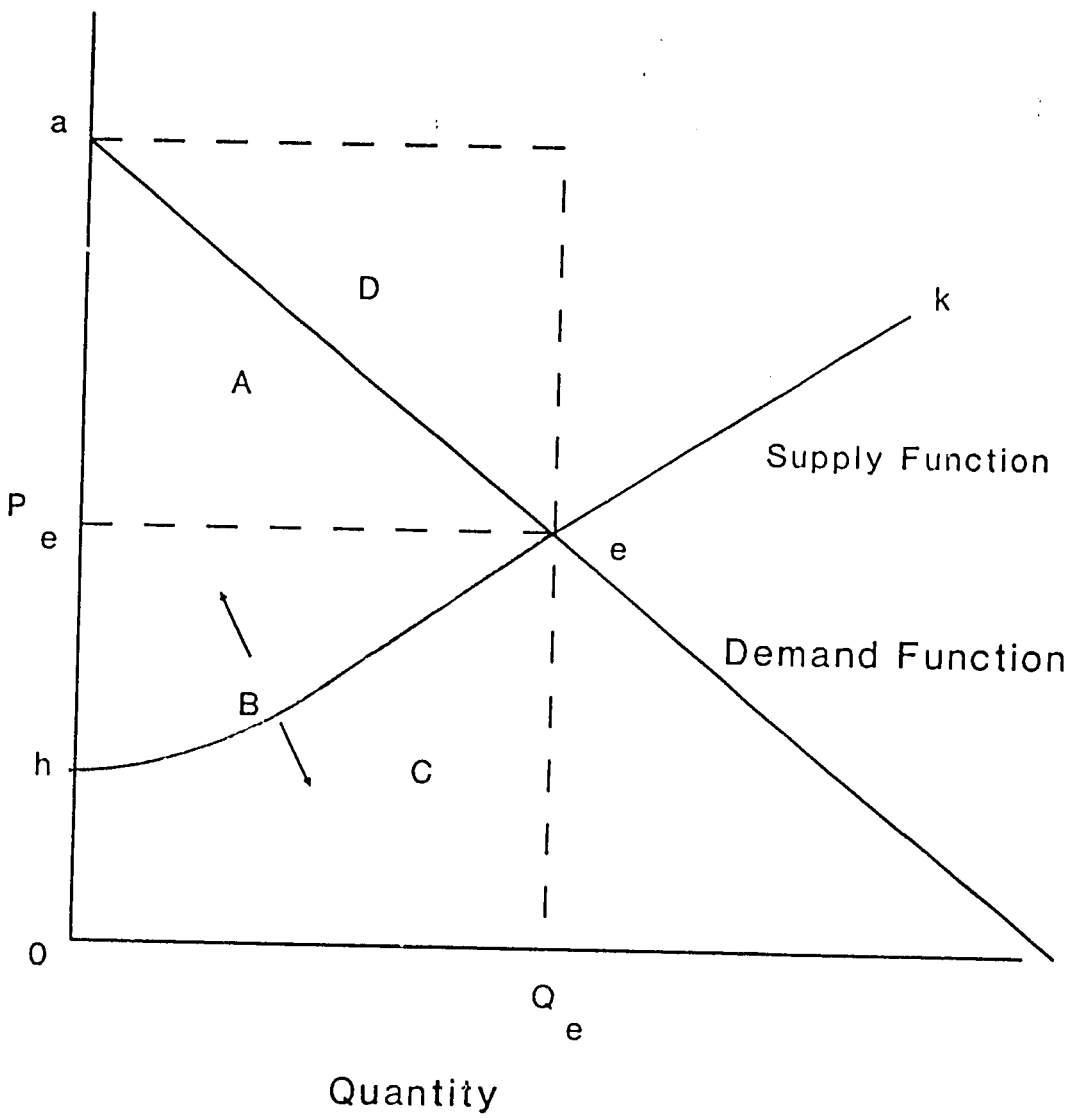
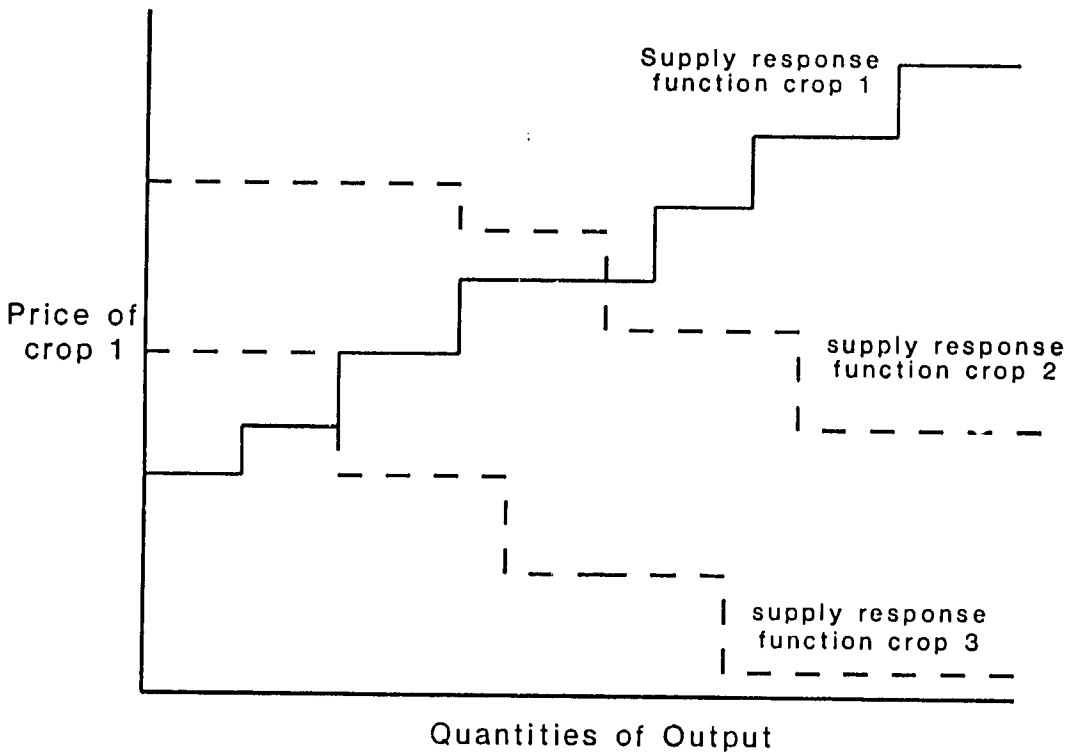


Fig. 2 SUPPLY RESPONSE FUNCTIONS IMPLICIT IN A SECTOR MODEL



the price at the farmgate) which are entered as costs into the objective function. Those values account for processing and distribution costs through the marketing channel, while conversion coefficients are included in the constraint equations which account for losses in quantity as product moves from farm to retail. Alternatively, any of the marketing functions can be modelled using budgets in the same manner as the farm sector. In that way various stages in marketing can be subjected to economies of scale, technological change or constraints on resources (storage or processing capacities). The main problem here is that the model can become very large if more than just a few commodities are included.

2.1.4 Fixed Prices and Other Non-Microeconomic Behavior in the Sector Model. A sector model is a microeconomic equilibrating model, assuming optimizing behavior by producers and consumers. It is often remarked that this does not represent the Pakistan economy; imperfect markets are the norm and government interventions are pervasive. However, the individual consumer certainly is price responsive (or, if not, the lack can be modelled by assuming a low elasticity), and production for subsistence can be modeled. Then, as long as producers are cost-minimizing, the model will represent actual behavior to a certain degree.

In principle, many imperfections in the economy can be accommodated within the model. Subsidies are easy to incorporate: subsidies on marketing wheat and on imported wheat are already in the model: distribution subsidies on fertilizer have also been included. The model can also incorporate segmented markets in demand or factor supply and imperfect resource mobility. While all of these are possible, the results assuming optimizing behavior are already quite good, and with minor variations, can be quite representative of behavior in the sector. In our opinion, we fail to reject optimizing behavior.

2.2 THE STRUCTURE OF THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM).

The PASM model (and a linear programming sector model in general) is designed to view together production and demand for crops and livestock, and do that in the context of the resources available to farms of different sizes and technologies, and in different regions. It further can: (1) account for losses, costs, and capacity constraints in marketing and processing farm products; (2) can incorporate supply response curves for inputs into production; and (3) have the farm production sector provide variable ration inputs to maintain livestock. Thus the sector model brings together production and demand for the entire sector in the face of resource scarcities, and includes agribusiness firms related to the basic production sector. As indicated above, it also solves for equilibrium retail and farmgate prices. An important additional feature is that it provides opportunity costs for a wide variety of resources used in agriculture.

How all of these economic factors are brought together is shown in Figure 3, where a simplified version of the PASM model is presented. (It is mainly simplified in that it does not show multiple regions and that it shows blocks of coefficients and their signs rather than the

FIGURE: 3

PASM: SIMPLIFIED TABLEAU

	PRODUCTION ACTIVITIES Crops/Livestock (Tons/ha; heads) Small Farms	Medium Farms	Large Farms	INPUT SUPPLY ACTVIT. Tons/Ha	ACTIVITIES DEFINING ALTERNATIVE FEED RATIONS	DIRECT MKTG. (Tons)	PROCESS/ MARKTNG. ACTVIT. (Tons)	DOMESTIC FINAL DEMAND (Tons/ Meters)	EXPORT ACTIVTS (Tons/ Meters)	IMPORT ACTIVITS. (Tons)	RHS
	XzjK			Jri		PRrj	PRrj	Dj	Ej	Mj	
NATIONAL CONSUMPTION S & D BALANCES						-	-1	1	1	-1	
REGIONAL PRODUCTION S & D BALANCES	-					1	1				
NATNL. INTERMEDIATE PRODUCTS/PROCESSING PROCESSING BALANCES	-							+			< 0
INPUT BALANCES	+			-1							
RESOURCE RESTRICTION SMALL FARMS	+										
RESOURCE RESTRICTION MEDIUM FARMS		+									
RESOURCE RESTRICTION LARGE FARMS			+								> B
LIMITS ON PROCESSING CAPACITY							1				
LIMITS ON EXPORTS									1		
LIMITS ON IMPORTS										1	
OBJECTIVE FUNCTION				-Pi		- j	- j	f(Dj)	f(DEj)/ PEj	-PMj	MAX

individual coefficients themselves). The following presentation assumes that the reader is familiar with a linear programming tableau. The tableau shown in Figure 3 implies a matrix ofcolumns and rows which are aggregated into groups of coefficients and equations that have similar structures.

2.2.1 The Columns (Activities) in the PASM Model. The columns represent activities which can be brought into the model solution and the rows represent equations imposing restrictions on the activities. From the left, the columns are activities for the acreage of each crop grown by farms in various regions and of different sizes. Next are the input supply activities, which are the total volumes of fertilizer, water, hired labor, etc., used by farms as they grow varying combinations of crops. The livestock maintained on different rations are found in the third set of columns. The values for those activities are the number of standard animal units maintained on a given ration.

The fourth group of columns are the marketing and processing activities required to move production from the farm to final demand. These values are in farm level quantities. There is a distinction between marketing, in which the farm product is converted to a retail quantity through a conversion coefficient, and its cost is the farm-retail price margin; and processing, in which the different steps which comprise the marketing activity are separated to give alternative technologies or costs. The latter has been incorporated to allow for specific detail on agribusiness activities. The second-to-last column has the activities for domestic demand. (There will naturally be differences between products at farm level and at final demand; broilers and layers at the farm level produce chicken meat and eggs for final demand, and cotton from the farm provides lint, oil and cake as outputs.)

The final columns show import and export activities. Just as there are marketing and processing activities needed to move farm quantities to final demand, the same activities are needed to move imports to final demand. For several important commodities (especially oilseeds), the processing of imports is also included. The export activities simply provide an alternative market for production in addition to domestic final demand.

2.2.2 The Constraint Equations (Rows) in the PASM Model. The rows in PASM are broadly split into three categories: the objective function, which includes prices of inputs and the value of the area under the demand curve at eleven points on each curve; the supply and demand balance rows (or transfer rows in standard linear programming parlance); and the resource restrictions rows. (The details of how these work are contained in the following section, which provides simple examples of the structure of a sector model.)

The Objective Function. The objective function calculates the value of consumer and producer surplus from producing, marketing, and importing/exporting major crops and livestock in Pakistan. The activities (columns) in a given solution are multiplied by the objective function coefficients and then are summed together. Costs are negative values, so that maximizing the objective function minimizes them. The points included for demand are positive values representing the area under the demand curve from the beginning of the curve until a particular

point, as indicated in the earlier section. The negative values for costs sum up to area C in Figure 1, and the positive values associated with final demand are in areas A and B. The maximization of the objective function thus makes A+B-C the greatest value possible. Additional costs of marketing and the specific values for the demand activities are discussed in detail in Annex II.

The prices of major inputs are included in the input supply columns. The activities in these columns are total quantities used of an input, such as fertilizer; the objective function coefficients are prices, so the product of the coefficients and activities is price times quantity or the total cost of the input, which enters the objective function. This formulation has several advantages. First, changes in the prices of an input can be simulated easily, simply by entering one value. Also, more complex factor supply curves can be simulated by using a combination of resource restrictions and input balance rows, which can be done without much revision of the model. The marketing and processing columns included in the objective function are the marketing margins associated with farm-to-retail price differences.

Several miscellaneous costs are included as objective function coefficients. The crop-specific costs of production for the three sizes of farms are found in the objective function in the first three columns of Figure 3. Included in those are seed, interest, water rate, artisan labor and thresher costs. To put these in the model directly would greatly expand its size because a separate row for each cost and farm size would be required. By putting all fixed costs into the objective function, the size of the model is reduced. (Simulating changes in these costs is somewhat more difficult in this formulation, although Lotus templates are being developed to make these changes easier). The costs associated with each hectare's production are outlined in Annex I.

In general the export and import coefficients in the objective function are prices, with export prices being positive values and import prices being negative. Thus, selling to exports increases the value of the objective function and buying from imports decreases it. The assumption for most commodities is that the export and import markets are perfectly elastic, i.e., the small country case is assumed. Also, markets can be similar to domestic demand, with downward sloping curves. This is included in the PASM model for basmati rice, which is the only clear commodity for which Pakistan is a market-maker.

Supply-Demand Balance Rows. The second group of equations, or rows in the matrix, are supply and demand balance rows. These rows make sure that any demand for a product is matched by a supply. In maximizing, the model will first choose quantities from the final demand columns because they offer positive values in the objective function. The model then has to guarantee that an adequate amount is produced and marketed, which is done through the constraints imposed by the supply-demand balance rows. These equations have supplies as negative values and demands as positive values and are set equal to or less than zero. Thus production can be either equal to demand or in excess of it. Excess costs are incurred if production exceeds demand, so there will be a tendency to just balance supply and demand.

Four broad categories of supply-demand balance equations are found in the upper half of Figure 3. The first are national consumption balance equations. These insure that the demand for consumption is supplied by marketings from one of the regions or from imports. Thus marketing and import activities carry negative signs, as they are the sources of supply. The marketing columns supply output to final consumption, and in turn demand raw products for processing from the farm sector in the supply-demand balance rows for regional marketings. The demand is positive and is matched by production, which has a negative sign. The coefficients in the production columns are the yields of each crop, so the multiplication of the column and coefficient gives total production. This provides the supply to meet the marketing system's demand.

The marketing system is presented in two different ways, depending on the commodity. In most cases, the marketing activity is one column, in which the coefficient in the tableau accounts for the quantities lost in moving from farm to retail and the costs in the objective function are the marketing margins. However, it is possible to have separate processing and marketing budgets included; also, if interested, alternative technologies in processing, such as expelling and solvent extraction of oilseeds, can be added.

The quantities found in the final demand columns are in thousands of metric tons at retail, so the supply-demand balance rows transfer thousands of retail metric tons from the marketing system to final demand. The balance rows for marketing and farm production are also thousands of metric tons, but at the farm level. The units of the production columns are thousands of hectares of each crop, which are then converted to farm level quantities in the supply-demand balance rows because the coefficients in those columns are yields.

Finally, the input balances have supply and demand relationships. As the farm sector produces commodities it also demands inputs, which are added together to give regional demands for inputs. These have to be balanced by supplies from input-supplying industries. The latter have negative coefficients, as they provide the supply, while the demands are requirements and have positive signs.

Resource Restriction Rows. The final types of equations in PASM are resource restrictions. These equations are characterized by positive coefficients in the tableau and a value greater than zero on the right hand side of the equation. Land is a prime example. Each production activity uses one hectare of land for each hectare of production, giving a coefficient of 1 in the tableau. The right hand side for that resource restriction (which has a general "b", for bound, in the figure) indicates the land available in a given region. The equation is a "less-than-or-equal-to" equation, so total use cannot exceed total availability.

Resources are restricted at several different levels. Some restrictions are made on each size of farm. These include land, family labor, crop rotation restrictions, and functions determining the level of marketable surplus for wheat and rice. Others occur at the zonal level. These are water, fertilizer, bullock labor, farmyard manure, livestock levels and ration input availability. The fact that these are not tied to individual farms means that there are assumed

to be markets (costless) functioning to move water or fodder to the best use. While this is a considerable assumption, it appears from the results to be robust and reduces the size of the model substantially. The livestock equations have equality constraints, so that livestock must be maintained at fixed levels; the model can choose rations but not the total population. This implies that livestock are not maintained on individual farms but rather are supported by the zone as a whole.

Hired labor is constrained only at the regional level, thereby making that market in PASM reflect regional competition. The final category are those restrictions which occur only at national or international levels. There are limits on the amounts which can be exported and imported, restrictions on the capacity available to process certain commodities, and restrictions on acreages of some crops, all of which are specified like resource restrictions.

2.2.3 Dimensions of the Pakistan Agricultural Sector Model. The previous discussion indicated that PASM includes the following: final demand for products from the agricultural sector; production and marketing of primary products from a variety of regions; and a set of commodities which can be imported or exported. Additionally there are a variety of agribusinesses providing input supplies and output services to the agricultural sector. The intent of this section is to show the regional and commodity coverage of PASM and to further show how resources have been restricted at different levels. Each major category is presented in separate subsections below.

Regional Coverage. The major part of the agricultural economy of Pakistan is brought into the model through several linked regional submodels. These submodels are in turn made up of agroclimatic zones with three representative farm sizes. Thus, the use of fertilizer, hired labor or tractor services on each crop might vary by the size and location of farm. Yields furthermore can vary. The availabilities of resources, such as land and water, additionally differ by the size of farm and location of the activity considered. Thus each zone has three farm sizes which have distinct technical coefficients for each crop and distinct comparative advantages in producing and marketing various crops.

Altogether there are eight zones in the model: three in the Punjab; two in the Sind; one in Balochistan and two in NWFP. The zone titles and districts included in each one are found in Table 1, along with the percentages of cropped area out into the major crops in each zone. In general, each zone has separate and limited resources to grow crops to be used for human consumption and as inputs to livestock rations. (The livestock estimated to exist in each zone must be supported by rations produced within that zone, which leads to different patterns of production because livestock herd levels vary by zone.) The exception is Zone 8 in NWFP, which contains the barani areas of NWFP and Punjab. Farm budgets differ in the two zones in NWFP because they reflect the technical coefficients of producing irrigated and barani crops. They do not have separate resources in the model but are treated as alternative technologies (activities) for which the availability of water determines the choice.

Table 1 CLASSIFICATION OF CROP ZONES IN SIND, PUNJAB, NWFP, AND BALOCHISTAN, 1990

Region and District	% Cropped Area Under:			
	Rice	Cotton	Sugarcane	Maize/Jawar
SIND				
Rice Zone				
Badin	73	16	---	---
Thatta	88	1	---	---
Karachi	9	7	---	---
Dadu	64	5	---	---
Larkana	99	0	---	---
Shikarpu	99	0	---	---
Jacobabad	99	0	---	---
Cotton Zone				
Tharparkar	1	16	---	---
Hyderabad	27	57	---	---
Sanghar	1	85	---	---
Nawabshah	2	70	---	---
Khairpur	2	74	---	---
Sukkur	7	68	---	---
PUNJAB				
Sugarcane Zone				
Sargodha*	29	24	30	17
Faisalabad	17	26	35	22
Cotton Zone				
Sahiwal	28	52	13	7
Multan	7	85	7	1
Vehari	9	78	10	3
Muzaffargarh	14	65	20	1
D. G. Khan	37	58	4	1
Bahawalpur	9	74	15	2
Rahim Yar Khan	8	73	16	3
Bahawalnagar	16	66	17	1
Mianwali	0	72	26	2
Jhang	24	54	17	5

Table 1, cont.

CLASSIFICATION OF CROP ZONES IN SIND, PUNJAB NWFP, AND BALOCHISTAN, 1990

Region and District	% Cropped Area Under:			
	Rice	Cotton	Sugarcane	Maize/Jawar
Rice-Zone				
Gujrat	72	7	18	3
Sialkot	87	3	5	5
Gujranwala	95	2	3	0
Sheikhupura	89	3	5	3
Lahore	76	3	16	5
Kasur	51	34	14	1
NWFP+PUNJAB BARANI				
Barani-Zone				
Attock	1	0	1	98
Rawalpindi	1	2	0	97
Jhelum	4	2	0	94
IRRIGATED				
Peshawar	NA	NA	NA	NA
Mardan	NA	NA	NA	NA

Source: Census of Agriculture 1980: Sind and Punjab.

*The crop-shares for Sargodha District are taken from acreage data reported in Agricultural Statistics of Pakistan 1983, because the cropping pattern given in Pakistan Census of Agriculture 1980, does not match with the latest changes in cropping pattern in this district, especially increase in sugarcane area and decrease in cotton acreage.

--- Zero or negligible area.

NA: Not applicable, because the basis of defining this zone is not the area under various crops.

Table 2

NATIONAL FINAL DEMAND PRODUCTS

INCLUDED IN

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(June, 1991)

Commodity	Model Name
Basmati Rice	RIB
Rice Other and Flour	RIO
Coarse Grains	COG
Cotton Fiber	CTF
Sugar	SUG
Pulses	PUL
Vegetables	VEG
Wheat and Wheat Products	WHE
Fruits	FRU
Vegetable Ghee	VGE
Liquid Oils	LOI
Beef	BEE
Milk	MIL
Butter	BUT
Animal Ghee (Desi)	AGE
Mutton	MUT
Poultry Meat	POU
Eggs	EGG

Final Demand. The commodities demanded by consumers in PASM are shown in Table 2. They include 11 products from crops and 7 livestock products. Some of these are joint products from production outputs: chickens produce both eggs and meat, and cattle produce milk, desi ghee and beef. Cotton provides lint and cottonseed, with the latter used for both oil and feedcake. Some other commodities are separated to reflect product differentiation. For example, there are two types of rice demanded, basmati and other rice, which are put into different demand curves to highlight differences in qualities and prices.

Final demand products are also aggregated to varying degrees depending on the commodity. The major commodities are fairly uniform, with only sugar containing both milled sugar and gur. Coarse grains are predominantly maize, but include guarseed, jowar and bajra in the kharif season and barley in rabi. Vegetables and fruits are other commodities which have been aggregated considerably for the purposes of this model. The details regarding these aggregations are included in Annex II.

Export and Import Commodities. The commodities which are imported or exported are given in Table 3. That table implies that PASM accounts for the overwhelming majority of agricultural products which are actually exported, including semi- and completely finished products from cotton. The major imported goods, also shown in the Table, require some explanation. First, there are in truth fruits and vegetables that are imported, but for the purposes of the model they are complements to domestic products and are not included because they do not compete with PASM vegetables and fruits. Also, milk imports include a wide variety of powdered and condensed products which have been aggregated together by converting them to fresh milk equivalents. Finally, two major imports, milk and sugar, did not come into the base solution, so they were given equality constraints and forced in at observed levels. Milk imports may not enter the model without constraints since they have a high average price by being specialized and high value added products. It is unknown why sugar imports did not appear, except that perhaps sugarcane's effectiveness in producing livestock rations led to excess production.

Production Activities. The outputs of the farm sector are found in Table 4. In many cases these correspond to the same products which are demanded by the retail consumer. However, there are other cases where either joint final demand products from one production activity exist or several production activities are aggregated into one output for consumption. The former include cotton, from which lint and cottonseed are produced (which is converted into oil and seedcake in the processing sector); and all oilseeds, which provide both edible oil and cake. Most products furthermore provide some ration component for livestock. Thus sugarcane tops are a by-product fed to livestock and maize leaves are stripped to provide fodder for animals. In addition, there is direct feeding of various percentages to livestock from each crop (See Annex 5 for details). Those products which are aggregated from production to final demand include coarse grains and barley, which are separate in production but both supply final demand for coarse grains. The final demand products of livestock activities come from several different production level activities as well, which will be discussed below.

Table 3

EXPORTED AND IMPORTED PRODUCTS INCLUDED IN

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Exports:	
Basmati Rice	RIE
Rice Other and Flour	RIO
Cotton Fiber	CTF
Vegetables	VEG
Fruits	FRU
Imports:	
Sugar	SUG
Pulses	PUL
Wheat and Wheat Products	WHE
Soybean Oil	SOYO
Palm Oil	PALO
Milk	MIL

Table 4

FARM PRODUCTION ACTIVITIES INCLUDED IN

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Rice Basmati	RIB
Rice (other)	RIO
Coarse Grains	COG
Cotton	COT
Sugarcane	SUG
Traditional Oilseed	TOL
Non-traditional Oilseeds	NOK
Pulses	PUL
Vegetables	HVA
Wheat	WHE
Barley	BAR
Non-traditional Oilseeds	NOR
Fruit	FRU
Milking Cows	MCA
Non-Milking Cows	NMC
Goats and Sheep	GOS
Poultry	POU
Eggs	EGG

Table 4 lists the crop categories when they come out of each zone as outputs of the farm production sector. These activities have additional variations which arise when looking at individual columns. Some products are grown both kharif and rabi (oilseeds, vegetables, pulses) and therefore are activities in both seasons. In the opposite manner, choosing either sugarcane or fruit in kharif uses land in both seasons, as they are assumed to be full year crops. Furthermore, there are two variations (and hence two different columns) in wheat and cotton which relate to crop rotations. Cotton can either have three or four pickings, which enter the model as separate activities; wheat also can be planted as regular or late wheat, with the latter arising when the crop choice in kharif is cotton or basmati rice.

Resource Restrictions. Resources are constrained at three different levels: farm, zonal, and regional levels. A resource such as land is restricted by size of farm. Thus, no more production of basmati rice, for example, can occur on small farms in the Rice Zone of the Punjab than there is land available to that farm type. Additional basmati production cannot use the technology or cost structure associated with that farm size and location. In contrast, if a resource is restricted only at the zonal or regional level, it is assumed to be available to all types of farms as needed. Farmyard manure is a resource that is restricted by zone, so any farm type within a given zone can use it. The resource will be allocated to the highest valued use through a presumed costless market.

The tables showing the resource restrictions are Tables 5-6. Land and family labor are shown to be available in differing amounts by size of farm and zone. In addition, each farm has to take into account rotation restrictions on planting basmati rice or cotton in kharif and early wheat in rabi. A fourth restriction is that farms can choose to produce wheat or rice for home consumption or purchase it from retailers. This constraint is not really a resource restriction; rather the farm sector incurs increased costs by purchasing wheat or rice from retailers because marketing costs are added if the farmer does not produce for home consumption.

Hired labor is the only resource which is explicitly restricted at the regional level. It is also priced within each region, indicating that there is a functioning market within the region, but which can differ between regions. Tractor services are priced at the regional level but are not restricted, so an infinite amount of tractor services is available to the farm sector at fixed prices, again which can vary by region.

Fertilizer is restricted at the zonal level to reflect its distribution ahead of use by the marketing system. It is priced at the regional level. Water is also available in limited quantities by zones implying costless transfers between farms within a given zone. This may not be realistic but it reduces the size of the model considerably and has not affected the performance of the model materially. Finally, livestock is forced into the model at the zonal level and so is not tied to each size of farm. Thus individual farms do not have to produce ration inputs to maintain livestock, but the zonal totals have to be adequate. This results in some excess specialization between farms to produce rations but it also reduces the size of the model. In view of the limited data on livestock, this seemed a reasonable aggregation, and, based on the results, is consistent with a decent performance of the model. Based on the livestock maintained

Table 5

FARM LEVEL RESOURCE RESTRICTIONS INCLUDED IN

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Family Labor inc. ploughing, Kharif	FALK
Land Availability, Kharif	LAK
Family Labor inc. ploughing, Rabi	FALR
Land Availability, Rabi	LAR
Rotation Limits for Basmati, Cotton and Wheat	ROBC
Market Surplus Function for Wheat	MKTSW
Market Surplus Function for Rice	MKTSR

Table 6

REGIONAL AND ZONAL RESOURCE RESTRICTIONS INCLUDED IN THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Regional:	
Hired Labor	HL
Total Tractors	TTR
Zonal:	
Nitrogen Fertilizer, Kharif	FENK
Phosphorous Fertilizer, Kharif	FEPK
Potash Fertilizer, Kharif	FEKK
Bullock, Kharif	BULK
Nitrogen Fertilizer, Rabi	FENR
Phosphorous Fertilizer, Rabi	FEPR
Potash Fertilizer, Rabi	FEKR
Bullock, Rabi	BULR
Farm Yard Manure	FYM
Canal Water, Kharif	CAWK
Canal Water, Rabi	CAWR
Tubewell Water, Kharif	TUWK
Tubewell Water, Rabi	TUWR

in each zone, farmyard manure and bullock labor are also provided in fixed amounts.

Livestock and Ration Inputs Used in PASM. Livestock is grouped into six categories in PASM, usually according to the output of meat or milk. These are in Table 7. Cattle and buffaloes are combined into milking and non-milking categories. The former provides only milk while the latter's output is beef. Goats and sheep are in a third category, which produce only mutton. There are finally three types of poultry: broilers, producing only meat; layers, which provide both eggs and meat as outputs; and desi chickens, which also provide both meat and eggs, although with a different productivity and ration use than layers.

PASM can choose to maintain each livestock category on three or four different rations, which are composed of components also listed in Table 7. The exception is desi chickens, which have only one ration per zone. The components are by-products of crop production. Wheat provides straw as a main by-product, but can also be fed directly as a feed made from wheat grain and bran. The amount of direct feeding of each crop is fixed as a proportion of total production, but it could alternatively be driven by relative costs and chosen according to what is least costly in each zone. (The original model was constructed this way but it was deemed hard to get reasonable results.)

Acreage Restrictions. Several additional restrictions were added to the model to make the base solution fit actual results. Altogether these only resulted in acreage constraints on 15 percent of total acreage, and there is a justification for using them to account for quality differences or institutional limitations of the model. In Table 8, limits are shown to exist for all oilseeds, kharif fodder and kharif pulses. Without the restrictions, oilseeds and kharif pulses came into the solution at much higher than observed levels and fodder came in at much less than actually grown in 1987/88. The reasons for these limits are discussed extensively in the results section below.

Table 7

LIVESTOCK MAINTAINED AND RATION USED IN THE

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Livestock Categories:	
Milking Cows, Buffaloes, Goats and Sheep	MCA
Non-Milking Cows, Buffaloes, Goats and Sheep	NMC
Goats and Sheep	GOSH
Broilers	BRO
Layers	LAY
Desi Chicken	DESI
Ration Inputs:	
Feed	FEED
Cake	CAKE
Straw	STRAW
Green, Kharif	GREK
Green Rabi	GRER
Pasture	PAST
Fishmeal	FISHM

Table 8

CROPS WITH ACREAGE LIMITATIONS IMPOSED IN THE

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

(JUNE, 1991)

Commodity	Model Name
Traditional Oilseeds, Kharif	LIMTOK
Non-traditional Oilseeds, Kharif	LIMNOK
Traditional Oilseeds, Rabi	LIMTOR
Non-traditional Oilseeds, Rabi	LIMNOR
Pulses, Kharif	LIMPUL
Fodder, Kharif	LIMFOK

2.2.4 Example Structures of Linear Programming Sector Models. In this section several simple examples are developed to show how a sector model works and to illustrate the types of equations described earlier in the report. The cases shown below increase in complexity until, in the last example, most of the main elements in a sector model are shown. If that example can be grasped the model is within reach of the analyst, because the main differences between that example and the real model are increases in dimensions. The structure remains the same.

For each example a linear programming tableau is presented with columns labelled across the top and row names given in the first column. The objective function is always the first row. Below the objective function is the tableau structure for the example presented. The final two columns give the type of restrictions on each row and the right hand side values.

EXAMPLE 1

TWO OUTPUTS, TWO INPUTS (UNPRICED)

	Rice	Wheat		
OBJ	1000	1100		
AREA	1	1	<=	1000
FERTILIZER	100	120	<=	100000

Example 1. Two Outputs and Two Inputs (Unpriced.) In Example 1, the simplest version of a sector model is described. The model can choose to produce either or both of two outputs, rice and wheat (in hectares) and uses land and fertilizer to produce them. Two types of equations from the discussion above are illustrated in this very simple model. The rows for fertilizer and area are resource restriction equations, while the objective function represents a second type of equation. The equations can be constructed from the tableau by recognizing that columns represent variables in the equation and values in the tableau are coefficients. So the two constraint equations are:

AREA:	Rice	+	Wheat	<=	1000
FERTILIZER:	100*Rice	+	120*Wheat	<=	100000

The first equation shows that the sum of the area in rice and wheat must be less than the available area of 1000 acres. The second equation shows that each hectare of rice requires 100 kilograms of fertilizer and each hectare of wheat requires 120 kgs. The total usage between the two crops must be less than 100,000 kilograms, the total availability of fertilizer.

The objective function describes the payoffs from producing each of the two products. In this case it is the net revenue per hectare of producing rice and wheat:

OBJ FN: 1000*Rice + 1100*Wheat = Maximum.

The objective of the problem is to produce both rice and wheat to maximize the value of the above equation. On first inspection it would be natural to choose wheat, which has a higher return per hectare. However, it also uses more fertilizer than rice, so it might be that planting rice on at least some of the land would increase revenues if fertilizer were the limiting resource.

EXAMPLE 2

TWO OUTPUTS, TWO INPUTS (ONE INPUT PRICED)

	Rice	Wheat	Fert		
OBJ	1000	1100	-6		
AREA	1	1		<=	1000
FERTILIZER	100	120	-1	<=	0
FERTILIZER L			1	<= 6	110000

Example 2. Two Outputs and Two Inputs, with One Input priced. In Example 2, the sample problem presents a slight elaboration over the first example in that a third column is included, Fert, which is the total usage of fertilizer. It has a value in the objective function of -6, the cost of one kilogram of fertilizer. Also, there are two equations for fertilizer, which are used to price that input and limit the quantities available. This is done through the combined effects of the following equations:

FERTILIZER: 100*Rice + 120*Wheat - Fert <= 0

FERTILIZER L: Fert <= 100000

The first equation represents an example of a supply-demand balance equation. The first two terms in the FERTILIZER equation are identical to those in the earlier example, which describe the total use of fertilizer depending on the amount of rice and wheat acreage brought into the solution. These of course represent the demands for inputs. The demands for fertilizer from producing wheat and rice cause the equation to be unbalanced -- the net value is greater than zero because the acreages of Wheat and Rice must be equal to or greater than zero. There must be supplies brought in to offset those demands, which is done by having Fert, the kilograms of fertilizer supplied, rise to match demand. With a negative sign, it brings the equation back into balance. The second equation limits the amount of fertilizer than can be supplied to 100,000 kilograms.

The objective function now changes as well to look like the following:

OBJ FN: 1000*Rice + 1100*Wheat -6*Fert = Maximum.

Again the first terms are similar to those in Example 1. However, the cost of fertilizer is deducted in the third term. Therefore, the returns to production of wheat and rice shown in this equation now deduct the costs of all inputs except fertilizer, which is subtracted separately to get the net return. This construction implies that fertilizer can be supplied up to 100,000 tonnes at 6 rupees per ton. Thus the nature of the fertilizer supply industry is specified. As will be demonstrated in a later example, these basic equations can be combined to simulate a further variety of agribusiness issues.

EXAMPLE 3

FOUR OUTPUTS, TWO INPUTS (ONE INPUT PRICED), TWO SEASONS

	Rice	Cotton	Wheat	Fodder	FertK	FertR		
OBJ	1000	1100	1200	700	-6	-6		
AREA K	1	1					<=	600
AREA R			1	1			<=	400
FERTILIZER K	100	110			-1		<=	0
FERTILIZER R			120	50		-1	<=	0
FERTILIZER LK					1		<=	60000
FERTILIZER LR						1	<=	40000

Example 3: Four Outputs, Two Inputs (One Input Priced), Two Seasons. A fairly straightforward extension shows how the model can take into account different seasons. There are now four outputs, with rice and cotton produced in kharif, and wheat and fodder produced in Rabi. The total hectares of land from the earlier examples are split into availabilities in two seasons, giving these two equations:

AREA K: Rice + Cotton <= 600

AREA R: Wheat + Fodder <= 400

Thus the sum of the acreage put into rice and cotton must be less than 600 hectares while the sum of wheat and fodder plantings must come to no more than 400 hectares together. The implication is that rice competes for acreage with cotton but not with wheat. The fertilizer equations are structured identically to the previous example except that there are two parallel sets of equations. Fertilizer use in rabi is different because the crops and availabilities of that input are different. Sixty thousand kilograms are available in kharif but only forty thousand can be used in rabi. It is of note that these resources cannot shift from one season to another. Kharif crops compete for fertilizer within that season but cannot access fertilizer from rabi, even if it would be in excess. (It is possible to structure interseasonal movements if that is seen to be important).

Example 4: One Output, Two Inputs (One Input with an Upward S loping Supply Curve), Marketing, Final Demand, Exports. This example incorporates several additional concepts. First, marketing margins, final demand, and exporting are included in the model. Also, an upward sloping supply curve is specified so that greater supplies of fertilizer only become available at successively higher prices. To do this, an extended number of columns and rows are included.

EXAMPLE 4

ONE OUTPUT, TWO INPUTS (UPWARD SLOPING SUPPLY), MARKETING, FINAL DEMAND, IMPORT AND EXPORT

	Rice	M&P	MEXP	FRT1	FRT2	C1	C2	EXP		
OBJ			-0.6	-5.0	-6.0	500.0	600.0	8.0		
RP	-1600.0	1.0	1.0						<=	0
RC		-0.5				700.0	900.0		<=	0
CCC						1.0	1.0		<=	1
REXP			-0.5					1.0	<=	0
REXPL								1.0	<=	100
AREA	1								<=	1000
FERTILIZER	100			-1.0	-1.0				<=	0
FERTILIZER1				1.0					<=	50000
FERTILIZER2					1.0				<=	50000

The first column allows for production of the output, Rice. That column is followed by two possible marketing channels, either domestic final demand, M&P, or exports, MEXP. The next two columns, FRT1 and FRT2, are put into the example to create the factor supply curve. The columns C1 and C2 represent two points on the demand curve for the product, while the last column, EXP, models the export market. The rows use these activities to make production consistent with demand and exports, while taking into account losses and costs in marketing. The rows also constrain fertilizer and land supply and make sure that those costs are taken into account in the objective function.

With regard to fertilizer, the relevant equations are as follows:

FERTILIZER:	100*Rice -FRT1 -FRT2	<=	0
FERTILIZER1:	FRT1	<=	50000
FERTILIZER2:	FRT2	<=	50000

Clearly the first equation is the supply-demand balance row, which insures that the demand for fertilizer derived from the production of rice is met by supplies. The main difference between this equation and the other examples is that there are two sources of supply, FRT1 and FRT2. The second and third equations impose limits on two potential sources of fertilizer, each of which can supply a maximum of 50,000 kilogra.ns. The key to determining which source will be used first lies in the objective function, where the prices of fertilizer from the two companies (or regions or countries) are given. The cost of bringing in fertilizer from FRT1 is 6 and from FRT2 is 10; therefore the 50,000 kilograms from FRT1 will be used first because it is cheaper. If it is profitable to use fertilizer that costs 10 rupees, the second source would come into the solution, up to 50,000 kilograms. In this manner two steps in an upward sloping supply curve are specified.

The marketing, final demand and export functions are all tied together in five different equations:

RP:	-1600*Rice	+	M&P	+	MEXP			<=	0
RC:			-.5*M&P	+	700*C1	+	900*C2	<=	0
CCC:					C1	+	C2	<=	1
REXP:			-.5*MEXP	+	EXP			<=	0
REXPL:					EXP			<=	100

The first equation ties production of rice to demand from the marketing system. The first term in that equation shows that rice production (column Rice) provides 1,600 kilograms for each hectare produced, which provides the supply for the marketing demands from either exports (MEXP) or domestic consumption (M&P). The second equation is also a supply-demand balance equation between supplies from the marketing system (so M&P has a negative sign on it) and the demand for final consumption. The construction using C1 and C2 is somewhat difficult and requires interpreting the third equation, the convex combination constraint (CCC) at the same time. From the CCC equation, one can see that C1 or C2 could be 1 or they could both enter the solution so that the sum of the two was equal to 1. The coefficients on C1 and C2 in the second equation are the quantities demanded at two points on the demand curve. If C1 is one, the quantity demanded is 700. Equation RC would then have to bring in 700 units from the marketing system, but since the losses in the system are 50% (the coefficient on M&P is .5), as production must be 1,400 units. Demand could then go to 900 if C2 were 1 or any value in between if the solution values of C1 and C2 both were non-zero.

The fourth and fifth equations tie exports to the production and marketing of rice. The fourth equation is the supply-demand balance equation for rice export. Similar to domestic demand, the marketing column, MEXP, supplies production to demand from the export market. However, export demand is a simpler construction than domestic demand because there is not a downward sloping demand curve implied. Rather the model has a fixed quantity which can be exported at a fixed price. The quantities which can be sold to exports are limited by the fifth equation to 100. The price of a unit exported is the value in the objective function.

All of these activities are subject to the maximization of the objective function, which is given below:

OBJ FN: -.6*MEXP -5*FRT1 - 6*FRT2 + 500*C1 + 600*C2 + 8*EXP = MAX

The last three terms give the positive values associated with demand, which are chosen first. For domestic demand, C1 and C2, the values are areas under the demand curve. The coefficient on exports, EXP, is the export price of rice. To sell to final demand or exports, however, the model must incur costs of fertilizer and marketing, which enter the objective function as negative values. The resulting optimal solution maximizes the sum of producer surplus, consumer surplus in the domestic market, and revenues in the export market.

Example 5: One Output, Two Inputs (One Input with Upward Sloping Supply Curve), Marketing, Final Demand, Exports. The final example shows how multiple regions are incorporated into a sector model. As in the previous example there is one national final demand (C1 and C2) and one activity for exports. The construction of equations related to these activities are essentially the same as the previous example. What is different is that the equations for each region are replicated twice and separated into groups of coefficients which

are in a block diagonal relationship. There are separate land, fertilizer supply and production/marketing equations (RP1 and RP2) for each region. What is unique in this example is how outputs from each region are tied to final demand and exports using the RC and EXP equations:

RC:	-.5*M&P1 -.4*M&P2 + 700*C1 + 900*C2	<= 0
REXP:	-.5*MEXP1 -.4*MEXP2 + EXP	<= 0

Supplies for final demand can come from either of the two regions, so that the most efficient supplier enters the solution first. Only if additional production is profitable will the second region enter the solution. Therefore, there are two marketing activities to domestic final demand in the first equation and two export activities in the second equation, allowing each type of demand to be filled from either or both regions.

EXAMPLE 5

ONE OUTPUT, TWO INPUTS (ONE INPUT UPWARD SLOPPING SUPPLY), MARKETING, FINAL DEMAND, IMPORT AND EXPORT

	P1	M&P1	MEXP1	FRT11	FRT12	P2	M&P2	MEXP2	FRT21	FRT22	C1	C2	EXP		
OBJ		-0.5	-0.6	-5	-6		-0.6	-0.7	-5.5	-6.6	500.0	600.0	8.0		
RC		-0.5					-0.4				700.0	900.0		<=	0
CCC											1.0	1.0		<=	0
REXP			0.5					-0.4						<=	0
REXPL													1.0	<=	0
RP1	-1600.0	1.0	1.0										1.C	<=	100
AREA1	1													<=	1
FERTILIZER1	100			-1	-1									<=	1000
FERTILIZER11				1										<=	0
FERTILIZER12					1									<=	40000
RP2						-1700	1	1						<=	50000
AREA2						1								<=	0
FERTILIZER2						120			-1	-1				<=	1200
FERTILIZER21									1					<=	0
FERTILIZER22										1				<=	60000
														<=	50000

III. RESULTS OF THE PAKISTAN AGRICULTURAL SECTOR MODEL

In this section the results to date of the PASM model are reported. First, a brief discussion is given of how the model was revised to make the current version close to the 1987/88 actuals, or how the model was "de-bugged". The following section reports the results in the current base solution of the model. That includes discussions of the base acreage values, both nationally and individually within the four regions, and of import and export values and the livestock maintained on different types of rations. A third section describes the effects of reducing some of the restrictions imposed on the model, notably the livestock restrictions and the restrictions on oilseed acreage. Finally, the fourth section presents selected further results, including price and quantity values for all commodities at retail and farmgate, and some of the quantities and shadow prices found for major inputs.

3.1 DEBUGGING THE PASM MODEL

PASM has been subjected to many different tests to try to make it correspond to the actual agricultural data for 1987/88. First, the team tried to make sure that the production side worked -- that the model could produce in each region the pattern of crops which existed in 1987/88 while also meeting estimated livestock feeding requirements. This test showed that the resources available in each region were adequate to meet both crop and livestock activities. It also produced shadow prices on the activities which corresponded to farmgate prices and which were usually close to actual prices. This effort involved breaking the model into its component regional supply models and forcing each region to meet actual demands for crops from the base year. Thus, there were four cost-minimization problems analyzed, which pointed out a number of problems but also indicated that the supply side of PASM could satisfy the necessary production at roughly the prices seen in each region during the base year. A number of other diagnostic tests were also applied and generally resulted in positive indications.

After cleaning each of the regional models, PASM was re-aggregated to a national model and the demand side was added. A number of errors were detected on the demand side and encouraging solutions were obtained. Since that point a number of adjustments have been made in an iterative fashion. The main objective has been to get the acreage correct in the main model. This involved simulating and then adjusting yields in some areas, livestock requirements, and/or demand elasticities. Different crops were sensitive to one or the other of these factors. Each change then required further, sometimes substantial, re-simulations.

3.2 THE BASE SOLUTION OF THE PASM MODEL

The base solution of this version of PASM is shown in Tables 9-14, which include the national acreage planted to each crop as well as the results for each of the four regions in the model. Furthermore, there are brief discussions of base solution livestock results and the

performance of the model in international trade. As the first objective was to validate the model by showing its ability to simulate the base year, 1987/88, a comparison of the acreage values in the model and actual values is included in most of these tables. The actual values refer to cropped acreage observed during that year. In the first column the hectares harvested during each year are given, followed by the simulation results. The third column gives the ratios of simulated-to-actual values. Any value where the simulated value is within 5 percent of the actual is considered to be quite good and within 10 percent to be acceptable. Values are reported for both kharif and rabi seasons.

3.2.1 Crop Acreage Results. The acreages of the major crops, -- rice, cotton, sugarcane, and wheat -- are quite consistent with actual levels. The fruit acreage is also surprisingly good; vegetables are close to actual acreage in kharif, but do not come into the solution in rabi, so overall they are low. The coarse grains acreage is somewhat low, especially since barley is considered a rabi coarse grain. Pulses also are a problem in rabi.

A number of crops have been constrained to their actual acreage rather than have them determined endogenously. The oilseeds acreage in both rabi and kharif was set to actual levels, except for non-traditional oilseeds, which have been set slightly higher to remind readers that they are constrained. In the absence of those constraints, oilseeds enter the model solution at much higher levels because they meet livestock feedcake requirements and efficiently provide edible oil to reduce imports. (The results of relaxing these restrictions are shown below). A number of alternatives were tried, such as reducing the marketing margins on imported oils and adding large risk factors to reflect marketing uncertainties, but they did not change the basic dominance of oilseeds. Therefore they had to be constrained for the moment.

This probably indicates that oilseed production is profitable but that uncertainties in institutional relationships are so large that producers will not take the risks of marketing those products. It suggests that a private-public "big-push" to make the marketing and distribution system more reliable and to provide basic extension services for production may pay off. As will be shown below, an important reason that the oilseeds come in at high levels is that they provide an effective way to meet the oilseed cake requirements for livestock feeding. Thus to capture the complete value of oilseeds, institutional arrangements need to include a system for producing and distributing feedcake.

Kharif fodder is also constrained. Without it being forced to its actual level, the green component required for livestock rations in kharif was adequately provided through by-products of other crops, so fodder only entered at about half its actual acreage. The reason appears to be that, in the current specification of the model, green from fodder is interchangeable with other crops' by-products. However, in actuality, fodder provides a ration input more consistently over the season than other crops because it can be cut regularly; it probably also provides better nutrients on average than other crop by-products. Forcing it into the solution in kharif is a way of accounting for a quality variation within the current specification of the model.

Finally, kharif pulses tended to enter the solution at much higher than observed values while rabi pulses were too low. The kharif acreage was therefore also constrained to actual levels, which shifted a large acreage into rabi. This is occurring primarily in NWFP, which has both irrigated and non-irrigated land lumped together. To show the distinction between production on barani and irrigated land, two types of technologies, or crop budgets, are included as activities in the model -- irrigated and unirrigated -- and the choice of technology is driven by the availability of water. Since water is rarely a constraining variable, too much acreage is probably put under irrigated technologies. This has led to too much wheat acreage on irrigated land and pulses in barani land, thus giving large acreage to pulses while at the same time their production is somewhat low. Perhaps this indicates a re-specification of NWFP is warranted, but that will be saved for later adjustments.

Overall, only about 15 percent of total acreage is forced into the model. Given the relatively good fit of the remaining 85% of acreage, this is quite a good result. Furthermore, most constrained acreage has a rationale for being restricted, such as to account for quality variations or institutional limitations which are not easily handled in the model. Therefore, PASM currently simulates most of the major crops quite well and additionally accounts for livestock feeding requirements.

3.2.2 Livestock Results. Throughout the development of PASM, the livestock component has been one of the most difficult to specify. Finding solid data on crop use in livestock rations has also been a problem. Accordingly, a large number of assumptions had to be made to develop alternative rations and the model has proven to be quite sensitive to these choices. For example, cotton acreage is affected strongly by the amount of feedcake put into livestock rations. Likewise, so is oilseed acreage.

Typically, sector models have trouble bringing a variety of rations into a solution at once, so it is difficult to have traditional and modern cattle feeding industries existing side by side, for instance. However, it is key that alternatives come into the solution if the development of livestock-based agribusinesses are to be examined. Recent developments in the methodologies used in sector modelling have helped and were incorporated into PASM. The results have been encouraging in that it has been possible to include a variety of rations for most livestock categories.

Table 9: PASM NATIONAL ACREAGE VALUES

SIMULATION ASSUMPTIONS: BASE SOLUTION FOR 1987/88
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	916.3	54.8	104.2
Other Rice	1127.7	1200.9	106.5
Coarse Grains	1740.4	1463.6	84.1
Cotton	2567.7	2494.6	97.2
Sugarcane	842.0	754.9	89.6
Trad. Oilseed	156.7	160.0	102.1
Non-Trad. Oilseed	6.6	28.3	428.6
Pulses	215.5	215.0	99.8
Vegetables	219.7	245.2	111.6
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	8606.3	96.9
Rabi:			
Wheat	7724.8	7417.8	96.0
Barley	152.7	0.0	0.0
Pulses	1052.0	1651.2	157.0
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseed	279.3	280.0	100.2
Non-Trad. Oilseed	21.7	21.7	100.0
Rabi Fodder	1293.9	1172.7	90.6
Fruit	415.6	389.8	93.8
	11130.9	10933.1	98.2

Sources: Actual Values, EAN Farm Income Estimates

Table 10: LIVESTOCK MAINTAINED ON ALTERNATIVE RATIONS

- Milking Cows	
Ration 1	3553.876
Ration 2	3988.015
Ration 3	4459.116
- Non-Milking Cows	
Ration 1	17722.896
Ration 2	0.000
Ration 3	1940.114
- Sheep and Goats	
Ration 1	0.000
Ration 2	5764.999
Ration 3	0.000
- Poultry-Broiler	
Ration 1	37362.568
Ration 2	0.000
Ration 3	24097.502
Ration 4	4110.002
- Poultry-Layer	
Ration 1	0.000
Ration 2	0.000
Ration 3	7679.997
Ration 4	
- Poultry-Desi	
Ration 1	15699.996

In Table 10 above, the number of animal units maintained on different rations are shown. The first ration is a "survival" ration, with a minimum of each type of feed -- grain, green, straw, and cake -- being fed to the animals on that ration. The second ration is one which is adequate and gives average yields. The third ration is similar to the second but with a different composition of ingredients. The fourth, where it exists, is a commercial, high-intensity feeding ration. The results are plausible: poultry is fed often on commercial rations; sheep and goats are treated well because they often are profitable enterprises; non-milking cows, used for bullock labor and then beef, are treated poorly in general, although there is a small, presumably commercial, cattle-feeding industry; and there is a range of strategies employed in feeding milking cows.

3.2.3 Export and Import Results. The results for exports and imports are an important indicator of a sector model's performance. With a good performance in international markets, many simulations can be run on changes in trade regimes, with the effects on imports, exports and other crops can be seen. Likewise, the impacts on trade from changing internal policies can be examined. The current exports in PASM include cotton, basmati rice, other rice, vegetables and fruit. Potential imports include wheat, sugar, pulses, milk products, and palm and soybean oil. All of these can be exported or imported up to given levels at fixed prices with the exception of basmati rice, which faces a downward sloping export demand function. In the latter case, export prices and quantities are endogenous to the model. For all other traded products, it is just the quantity.

The quantity limits are set at approximately the levels of observed exports and imports in 1987/88. Pulses, edible oils and wheat are all imported to their observed levels. The imports of sugar and milk did not come into the solution except when they were forced into the solution. For milk, this was probably because imported milk was of higher value (a differentiated product) and, when converted to raw milk equivalents, it was not competitive. Forcing it in to the solution was one way to account for product differentiation in milk products. A similar argument may follow for sugar, or it may be, as indicated earlier, that sugar by-products used for feeding make cane production more attractive than is actually the case.

Exports of other rice, cotton, vegetables and fruit are all at observed limits. Basmati rice exports exceed the actual quantity (at about 275,000 MT versus 220,000 MT actual exports) and implied prices are too low. In part this is because production yields are too high for rice (the model finds the most efficient areas in which to produce) and partly because the area is somewhat high for basmati rice as it is profitable for the sector to produce for export even at low prices.

3.2.4 Regional Solution Values of PASM, 1987/88. The PASM model is constructed from seven zones in four regions, which interact as a national model. The previous tables have shown results at the national level. In this section, regional results are presented. While it is possible to present zonal results, for most purposes the best analysis is at the regional level. As will be shown, the more disaggregated the models become, the less accurate they are. Because costs of production are minimized, the model makes a more efficient selection of where to

produce than actually occurs. This means that there is a smaller likelihood of the model simulating actual acreage at the regional level than nationally. And the smaller the region, the less likely that there will be an exact match. A final reason that excess specialization occurs is that the model is currently specified with just one national demand rather than location specific demands in each region, so there is no cost associated with producing far away from demand.

In PASM, constraints imposed on acreage are at the national level only. The model can therefore choose in which regions it wants to actually produce the crop, so regional acreage is not restricted. This means that the relative profitability of producing oilseeds and fodder, the main products which are restricted at the national level, can still be seen in the regional results. Another form of restriction on acreage occurs when the model leaves out an activity completely in a given region. For instance, for technical reasons basmati rice is not grown in the Sind; therefore no columns for basmati were put in the Sind and that crop could not come into the solution there. Other constraints similar to these can be seen by comparing the list of crops grown in each region.

Punjab Regional Acreage Values. The results of the base solution for the Punjab are found in Table 11. The overall acreage is close to that actually observed (in fact exceeds it because less fruit is grown, which frees twice as much acreage because fruit is an annual crop and additional crops can be grown on the released acreage). Many of the individual commodities are also close to actual values. Among the main crops, basmati rice, cotton, wheat, and rabi pulses are produced quite close to actual levels. In other crops, there appear to be clear advantages and disadvantages implied for the Punjab. In kharif, more Irri rice is produced than was observed in 1987/88, as were coarse grains and vegetables. Fewer pulses and sugarcane were grown. Rabi fodder was produced quite close to actual values but fruit was produced at less than half its actual level.

Sind Regional Acreage Values. The hectares planted to different crops in the Sind are given in Table 12. The total simulated acreage was nearly the same as actual in kharif but somewhat less in rabi, indicating perhaps that other resources were more constraining in that season. Cotton, other rice, rabi fodder and fruit were close to their benchmark values. Wheat, sugarcane and traditional oilseeds were much higher when simulated than the amounts actually produced, while coarse grains, pulses, rabi vegetables and oilseeds were lower than expected.

Balochistan and NWFP Regional Acreage Values. The smaller regions can not be expected to perform as well as large ones, at least on a percentage basis. While this is clearly true in Balochistan in kharif, (shown in Table 13), rabi crops which are grown in that region are relatively close to what they should be, especially pulses and fruit. At 5 percent of the total acreage, the results in Balochistan do not materially affect the general performance of the model.

In NWFP the most divergent results are found. Basmati rice does not come into the solution at all, nor do kharif traditional oilseeds or sugarcane, three fairly important crops in that region. The largest problem is, as indicated in the national acreage discussion, that wheat acreage is less than half of what it should be, but pulses are about eight times and traditional

oilseeds are five times the acreage they should be. This most likely results from the separation into irrigated and barani lands, which will be re-specified. The fact that barley does not enter the solution may also come from this specification, as half of all barley is supposed to be grown in NWFP but is not produced at all.

A Summary of the Regional Results. The regional values reflect relative efficiencies in the technologies used in each region. This is not only true within a given crop, but because the model accounts for opportunity costs in a wider sense, the relative efficiencies of different crops and resource environments in each region may be compared. Thus the comparison may not always be straightforward. While the general conclusion is that for most crops and regions, the performance has been adequate, there are still some tendencies which can be investigated further to fine-tune the model.

Nationally rice is produced at about 5 percent greater than observed values. However, the Punjab takes more than its fair share of that increase, by producing far above observed values in both types of rice, which suggests a comparative advantage in rice, according to our budgets. The Sind and NWFP produce less rice than expected. A number of other crops were produced nationally at somewhat less than observed values: coarse grains, cotton, and sugarcane acreage were 5-10 percent less than observed. However, on a regional basis, the Punjab produced excess coarse grains but the Sind did not produce any at all. The latter may have to do with the livestock requirements in the two regions as much as anything. The somewhat lower total acreage for cotton mostly occurred in the Punjab, as the Sind, the other major producer of cotton, grew nearly what was expected.

Perhaps the largest problems have to do with pulses and wheat, which appear to be the most regionally out of kilter, primarily because of problems in NWFP. All kharif pulses and most rabi pulses are produced in NWFP, with some rabi pulses also in the Punjab. While wheat is produced in both Punjab and Sind beyond what was expected, NWFP simulated only half its actual production. As indicated in the earlier discussion of the national results, this may arise from problems in the specification of NWFP, but the regional results indicate it also feeds through to the other regional results. Correcting this problem is left for further work.

Table 11: PASM PUNJAB ACREAGE VALUES

SIMULATION ASSUMPTIONS: BASE SOLUTION, 1987/88
('000 HECTARES)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	809.8	874.6	108.0
Other Rice	274.8	528.5	192.3
Coarse Grains	776.3	888.4	114.4
Cotton	1934.4	1900.6	98.3
Sugarcane	534.9	417.2	78.0
Trad. Oilseed	25.4	0.0	0.0
Non-Trad. Oilseed	0.0	28.3	---
Pulses	119.4	0.0	0.0
Vegetables	118.7	245.2	206.7
Kharif Fodder	1003.0	903.7	90.1
	5596.5	5786.6	103.4
Rabi:			
Wheat	4927.4	5266.2	106.9
Barley	44.0	0.0	0.0
Pulses	723.5	729.0	100.8
Rabi Vegetables	75.1	0.0	0.0
Trad. Oilseed	122.9	0.0	0.0
Non-Trad. Oilseed	0.0	21.7	---
Rabi Fodder	1051.2	943.8	89.8
Fruit	277.4	107.1	38.6
	7221.5	7067.8	97.9

Sources: Actual Values, EAN Farm Income Estimates

Table 12: PASM SIND ACREAGE VALUES

SIMULATION ASSUMPTIONS: BASE SOLUTION, 1987/88
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Other Rice	721.8	599.5	83.1
Coarse Grains	158.4	0.0	0.0
Cotton	629.6	594.0	94.3
Sugarcane	207.1	337.7	163.1
Trad. Oilseeds	8.3	160.0	1930.5
Non-Trad. Oilseed	5.4	0.0	0.0
Pulses	17.3	0.0	0.0
Vegetables	42.9	0.0	0.0
Kharif Fodder	0.0	53.4	0.0
	1790.7	1744.6	97.4
Rabi:			
Wheat	1024.8	1192.5	116.4
Barley	25.8	0.0	0.0
Pulses	192.4	0.0	0.0
Rabi Vegetables	33.4	0.0	0.0
Trad. Oilseeds	80.4	0.0	0.0
Non-Trad. Oilseed	5.4	0.0	0.0
Rabi Fodder	150.4	145.4	96.7
Fruit	80.8	126.4	156.4
	1593.4	1464.3	91.9

Sources: Actual Values, EAN Farm Income Estimates

Table 13: PASM BALOCHISTAN ACREAGE VALUES

SIMULATION ASSUMPTIONS: BASE SOLUTION, 1987/88
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	11.2	80.1	715.4
Other Rice	83.7	39.7	47.4
Coarse Grains	38.4	0.0	0.0
Sugarcane	0.5	0.0	0.0
Trad. Oilseed	1.3	0.0	0.0
Pulses	4.7	0.0	0.0
Vegetables	29.2	0.0	0.0
Kharif Fodder	10.2	33.2	325.2
	179.2	153.0	85.3
Rabi:			
Wheat	183.3	249.7	136.2
Barley	11.1	0.0	0.0
Pulses	25.5	23.1	90.7
Rabi Vegetables	19.5	0.0	0.0
Trad. Oilseed	18.9	0.0	0.0
Non-Trad. Oilseed	15.1	0.0	0.0
Rabi Fodder	15.1	0.0	0.0
Fruit	27.7	29.2	105.3
	316.2	302.0	95.5

Sources: Actual Values, EAN Farm Income Estimates

Table 14: PASM NWFP ACREAGE VALUES

SIMULATION ASSUMPTIONS: BASE SOLUTION, 1987/88
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	95.3	0.0	0.0
Other Rice	47.4	33.3	70.2
Coarse Grains	767.4	575.2	75.0
Cotton	3.7	0.0	0.0
Sugarcane	99.5	0.0	0.0
Trad. Oilseeds	121.7	0.0	0.0
Non-Trad. Oilseed	1.2	0.0	0.0
Pulses	74.2	215.0	289.7
Vegetables	28.9	0.0	0.0
Kharif Fodder	75.5	98.7	130.7
	1314.8	922.21	70.1
Rabi:			
Wheat	1589.3	709.3	44.6
Barley	71.8	0.0	0.0
Pulses	110.6	899.0	812.7
Rabi Vegetables	62.9	0.0	0.0
Trad. Oilseeds	57.1	280.0	490.2
Non-Trad. Oilseed	1.2	0.0	0.0
Rabi Fodder	77.1	83.5	108.4
Fruit	29.7	127.1	427.8
	1999.8	2099.0	104.9

Sources: Actual Values, EAN Farm Income Estimates

3.3 THE IMPACT OF REDUCING RESTRICTIONS IN THE PASM MODEL

PASM, in its current version, has several activities forced into the base solution at fixed levels. The most important of these are livestock activities, where the choice of rations is endogenous but herd levels are fixed at observed levels. Also, fodder acreage has been forced into the solution during kharif because the model provides an adequate volume of the green ration component without producing as much fodder as actually found during 1987/88. This, we argued, is because the model does not account for the probable advantages of fodder -- a continuous flow of feed and higher quality nutrients. In addition, oilseed acreage is restricted to actual levels because no adjustments in coefficients reduced the tendency of that commodity to come in at much greater than observed levels. The following discussions present the effects on the model solution from lifting each of these restrictions.

3.3.1 Reducing Livestock Restrictions. The six types of livestock in PASM are "forced" into the solution at specified levels in each zone. Furthermore, enough livestock ration components must be grown within the zone to support its herd. This has been implemented by setting the herd level equations to equality constraints, thereby making the model maintain exactly the number of animals on rations found within the zone. The first simulation involved changing these constraints to "less than or equal to" constraints, so that PASM could choose the amount of livestock it wished to support based on the costs of feeding versus the gains from selling to final demand. A summary of the results are contained in Tables 15 and 16 below.

The first table, Table 15, compares the livestock results in the base solution with herd levels chosen endogenously. The model chose to have milking cows at nearly the actual levels observed during the base year. Also, the number of laying chickens, which provide both eggs and chicken meat, would be about what the flock appears to be. Non-milking cows, whose main benefit in the current version of the model are to provide beef, enter the solution at just over 60 percent of actual levels. This is because the demand for beef is small and the other uses of these animals, for breeding and animal traction, are not endogenous to the model; those benefits are therefore not tied to the herd size of non-milking cows. This could be expanded in a later version of the model. Since bullock labor available is also in excess quantities, it may be that the actual herd size is too large due to poor animal husbandry practices. Broilers also are not chosen near the levels which actually exist.

The final two categories, sheep and goats and desi poultry, come in at their limits, which suggests that if the model were completely unconstrained it would choose larger numbers for these classes of livestock. For sheep and goats, the strong general demand and low costs of feeding make this a profitable activity. For desi chickens, the low cost of raising them means that they are chosen. While the model would probably choose desi chickens in place of broilers, this may not be feasible because in reality they may be a difficult herd to expand. Also, our yields of eggs and chicken meat from them may be too high. More complex relationships between herd size, provision of meat, and animal husbandry practices could be created but will be saved for later work.

Table 15: Livestock Maintained on Alternative Rations

Livestock Category	1987/88 Actual	Restrictions Released	% Actual/ Preferred
Milking Cows	12,001	11,726	97.7
Non-Milking Cows	19,663	12,981	66.0
Sheep and Goats	5,765	5,765	100.0
Poultry-Broiler	65,570	38,843	59.2
Poultry-Layer	23,380	20,829	89.0
Poultry-Desi	56,940	56,940	100.0

The crop pattern which emerges when livestock restrictions are lifted is included in Table 16. (However, note that fodder continues to be restricted to account for its better quality as a ration input. Fodder could have been unrestricted in this simulation as well.) Of most importance, when the model chooses livestock activities endogenously, the total land required drops significantly. In kharif, the land required to optimize the sum of producer and consumer surplus is down nearly 700 thousand hectares, from 97.1 of the actual to 93.5 percent. Thus, the release of resources from producing for livestock rations are not re-deployed fully, suggesting that there are effective demand constraints operating. A second conclusion is that the resources currently employed in agriculture are sufficient to optimally meet demands for both crop and livestock requirements (assuming that the farm sector can optimize as a linear program does). The decrease in acreage used is less in rabi but the direction is the same.

Additionally, there are shifts in the crops produced. Basmati increases in area about 9.5 percent but other rice drops about 1.2 percent. The large increase in basmati results from the downward sloping demand function for its exports, so that it has a greater potential to expand demand than do the other commodities. Several other crops also increase their acreage by up to five percent relative to the base solution: coarse grains, cotton and fruit. It appears that these are crops for which there is potential demand not being satisfied in the base solution. With extra land and other resources available, these crops are added. Sugarcane drops over 10 percent, suggesting that part of the reason it is produced is to provide a ration component. With less livestock, there is less need for its production. Finally, in rabi, wheat adds about 100 thousand hectares and pulses increase by nearly 300 thousand hectares.

3.3.2 Removing Oilseed Restrictions. In the early stages of debugging PASM, oilseeds dominated acreage because they could reduce imports, provide feedcake and produce vegetable ghee and liquid oil, which are high-valued products. Therefore, they were restricted to get a base solution which was reasonable. The impacts of lifting those restrictions are given in Tables 17 and 18. The first table shows the effects when feedcake requirements for rations from the base model were used. These were 60-80 percent of our original data values, but cotton acreage only became correct by reducing these coefficients. These being quite tentative, it was felt to be an acceptable revision. The second table shows the effects of lifting oilseed restrictions when feedcake requirements were set at our initial values.

Quite clearly, in both instances the acreage of oilseeds increase dramatically when the constraints are removed. This is true for both traditional and non-traditional oilseeds. The main qualification is that non-traditional oilseeds do not come into the solution in rabi when there are reduced feedcake requirements. In the first simulation, increased production does not remove imports of either soybean or palm oil, but rather more domestic demand is met from oilseeds rather than from cottonseed oil. In the second simulation, nearly all palm oil imports are replaced by domestic production. This occurs because the prices for palm oil include tariffs so their costs are the same as soybean oil. Without those restrictions, the higher cost soybean oil would be replaced.

Table 16: PASM NATIONAL ACREAGE VALUES

SIMULATION ASSUMPTIONS: LIVESTOCK RESTRICTIONS RELEASED
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	916.3	1041.9	113.7
Other Rice	1127.7	1167.6	103.5
Coarse Grains	1740.4	1360.1	78.1
Cotton	2567.7	2337.6	91.0
Sugarcane	842.0	669.5	79.5
Trad. Oilseeds	156.7	160.0	102.1
Non-Trad. Oilseed	6.6	28.3	428.6
Pulses	215.5	215.0	99.8
Vegetables	219.7	233.5	106.3
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	8302.5	93.5
Rabi:			
Wheat	7724.8	7507.9	97.2
Barley	152.7	0.0	0.0
Pulses	1052.0	1969.6	187.2
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	280.0	100.2
Non-Trad. Oilseed	21.7	21.7	100.0
Rabi Fodder	1293.9	874.6	67.6
Fruit	415.6	423.1	101.8
	11130.9	11076.8	99.5

Sources: Actual Values, EAN Farm Income Estimates

Table 17: PASM NATIONAL ACREAGE VALUES

SIMULATION ASSUMPTIONS: OILSEED RESTRICTIONS RELEASED
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	916.3	974.5	106.4
Other Rice	1127.7	1242.8	110.2
Coarse Grains	1740.4	1479.0	85.0
Cottcn	2567.7	1893.3	73.7
Sugarcane	842.0	702.1	83.4
Trad. Oilseeds	156.7	313.1	199.8
Non-Trad. Oilseed	6.6	476.7	7218.1
Pulses	215.5	215.0	99.8
Vegetables	219.7	245.7	111.9
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	8631.2	97.2
Rabi:			
Wheat	7724.8	7398.7	95.8
Barley	152.7	0.0	0.0
Pulses	1052.0	1753.1	166.6
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	254.0	90.9
Non-Trad. Oilseed	21.7	0.0	0.0
Rabi Fodder	1293.9	1169.2	90.4
Fruit	415.6	383.7	92.3
	11130.9	10958.6	98.5

Sources: Actual Values, EAN Farm Income Estimates

Table 18: PASM NATIONAL ACREAGE VALUES

SIMULATION ASSUMPTIONS: OILSEED RESTRICTIONS RELEASED
FEEDCAKE REQUIREMENTS INCREASED
('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated Actual
Kharif:			
Basmati Rice	916.3	909.6	99.3
Other Rice	1127.7	1221.9	108.4
Coarse Grains	1740.4	1412.9	81.2
Cotton	2567.7	1988.7	77.4
Sugarcane	842.0	698.9	83.0
Trad. Oilseeds	156.7	548.7	350.1
Non-Trad. Oilseed	6.6	848.9	12855.8
Pulses	215.5	215.0	99.8
Vegetables	219.7	249.0	113.4
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	9182.6	103.4
Rabi:			
Wheat	7724.8	6801.9	88.1
Barley	152.7	0.0	0.0
Pulses	1052.0	1366.4	129.9
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	823.2	294.7
Non-Trad. Oilseed	21.7	392.9	1810.3
Rabi Fodder	1293.9	1178.9	91.1
Fruit	415.6	362.0	87.1
	11130.9	10925.2	98.2

Sources: Actual Values, EAN Farm Income Estimates

There are some interesting responses in other crops as well. Since the directions are the same in both simulations, we restrict our attention to the second simulation, where the effects are more pronounced. First, there is a reduction in the production of basmati rice and an increase in other rice. Given the quite possible inelastic export demand for basmati but elastic curve for other rice, these changes could increase export earnings. The acreages of coarse grains, sugarcane and cotton all decline from the base solution, with cotton losing acreage by about 20 percent. These effects most likely arise because the increased oilseed acreage also provides ration inputs for livestock, so cotton is only needed to meet final demand for lint. Cotton is "king" until the demand for lint has been met. Beyond that, the provision of oil and meal per acre is better from oilseeds so the remaining supply comes from oilseeds.

3.4 EXTENDED RESULTS: PRICES AND QUANTITIES AT FARMGATE AND RETAIL; USE OF MAJOR INPUTS

The previous discussion centered on acreage results, which are most often used to test the accuracy of a sector model. In addition, however, there is a large amount of information contained in the dual and primal solutions beyond the acreage results. Of most importance, national retail and farmgate prices in each region are the dual values on national and regional supply-demand balance rows. Farmgate and retail quantities can also be tabulated from the marketing activities in the primal solution. The opportunity costs on resources such as land, family labor and fertilizer are also included in the dual solution. The first two of these vary by farm size and are quite variable. To present them a scheme for weighing the result of each farm size needs to be put together. These are therefore not reported. However, quantities of fertilizer and opportunity costs of additional units in each zone can be compiled easily.

The following three tables present the base solution values for variables which represent extended results of the model. In the first table, Table 19, the quantities and prices of products at the national retail level are presented. The second table, Table 20, shows farmgate prices derived from the model as well as actual results for 1987/88. These are based on a weighted average of regional results rather than national values. The final table, Table 21, shows the quantities used and the dual prices for several major inputs used in the model -- fertilizer, hired labor and tractor services. They are compared with actual prices and availabilities for the base year as well. Each of these tables are discussed in the sections below.

Retail Prices and Quantities. Table 19 shows the prices and quantities for each commodity demanded at retail in the base solution. The first column shows prices from the Base run, while the second and third columns provide comparisons with actual prices during 1987/88. The second column provides actual prices while the third column summarizes differences between the simulated and actual values. The same presentation is made for quantities consumed at retail in the last three columns of the table.

Using the same criteria applied to evaluating acreage, that values within 5 percent of actual levels are quite good and within 10 percent are decent, an inspection of Table 19 shows

that performance with regard to quantities is usually adequate. Cotton, coarse grains, sugar, vegetable ghee, liquid oil and fruit enter the model at almost exactly the quantities that were actually sold to final demand. Other rice is only 10 percent off the total, and the other major crop products are nearly within the acceptable 10 percent range. Wheat is somewhat low while vegetables and basmati rice are slightly on the high side. The crop with the most problems is pulses, which comes in the solution at almost twenty percent lower than actual results.

TABLE 19

NATIONAL AVERAGE FARM QUANTITIES PRODUCED AND FARMGATE PRICES
BASE PASM SIMULATION RESULTS AND ACTUAL, 1987/88

COMMODITY	PRICES (RS/MT) PASM	PRICES (RS/MT) ACTUAL	PRICES (RS/MT) % PASM OF ACTUAL	QUANTITIES (MT)* PASM	QUANTITIES (MT)* ACTUAL	QUANTITIES (MT)* % PASM OF ACTUAL
CROPS:						
Basmati Rice	3,780	3,469	109.0	1,088	943	115.33
Other Rice	1,683	1,580	106.6	2,883	2,298	125.46
Coarse Grains	2,264	2,626	86.2	1,643	1,745	94.14
Cotton Fiber	2,604	3,094	84.2	1,642	1,563	105.08
Sugarcane	234	306	76.7	29,751	33,040	90.04
Trad. Oilseeds	10,653	7,574	140.7	669	303	220.57
Non-Trad. Oilseeds	23,505	--	ERR	37	8	465.05
Pulses	7,077	5,524	128.1	533	557	95.78
Vegetables	81	2,785	2.9	3,954	3,537	111.78
Wheat	2,276	2,043	111.4	12,123	12,957	93.56
Fruit	2,173	3,908	55.6	3,592	3,601	99.74
LIVESTOCK:						
Beef	3,026	--	ERR	1,858	1,324	140.33
Milk	37	--	ERR	11,392	10,436	109.16
Butter	--	--	ERR	84	--	ERR
Animal Ghee	--	--	ERR	2,097	--	ERR
Mutton	12,457	--	ERR	1,066	1,267	84.14
Poultry	15,728	--	ERR	163	154	105.65
Eggs	0	--	ERR	5,341	4,140	129.00

*Except eggs, which are in Rs. Billion

The livestock values are similarly good, with many products being inside the 10 percent range. The quantities consumed of milk have less than 5 percent differences from actual retail figures. Animal ghee and chicken meat are only slightly beyond a 5 percent difference, and mutton is consumed in the model at only slightly under 90 percent of actual values. The primary problems occur with beef and eggs; these arise most likely from forcing livestock herd levels into the solution at fixed levels, problems which are discussed further in the following section.

It is not entirely clear that quantities should be expected to be as close to actual values in percentage terms as acreage. Given a correct acreage, quantities will tend to be on the high side because the model usually sees land as the scarcest resource and chooses activities where yields are the highest. Given a good result in acreage, therefore, the quantities produced and consumed will most likely be high. (This is not always true though. Wheat acreage, for instance, is 97.2 percent of actual acreage and yet retail quantities are still lower, at 88.9. The problem appears to be that other input scarcities besides land cause wheat to be produced on farm sizes which have less than average yields.) The primal solution needs to be reviewed to see if just a few farm sizes are used extensively in the production of some crops. By lowering those yields, to reflect decreasing performance as more land is put into a given crop, the quantities coming into the market may come back into line for the few crops where they are too high.

Prices are a bigger problem than quantities. If a product was consumed at higher than actual quantities, the price was usually farther off on the low side, for both crops and livestock. This is simply the effects of the elasticities chosen to represent the final demand curves, which were usually inelastic. (See Annex II for actual values). So, if quantities are too large by 10 percent and the elasticity is .5, prices will be off by 20 percent in the opposite direction from the movement along the demand curve. Thus prices will perform as well as quantities only when the elasticities are greater than 1. The biggest problems in crops are for rice, pulses, vegetables and wheat, whose prices are quite far from what they were expected to be in that year. For wheat and pulses, a straightforward increase in the elasticity should help, since the correction should give lower prices and higher quantities. Fixing the results in rice is more difficult because increasing prices by raising elasticities may also raise quantities. It may be best to do this in combination with a review of the yields used in producing basmati and other rice.

Farmgate Prices and Quantities. The national farmgate quantities and weighted national prices are given in Table 20. It is structured similarly to the previous table except that quantities are summations from four regions and prices are the sum of dual values in each region, weighted by regional quantities. Furthermore, most products had some output being fed to livestock. To take account of this use, the quantities have been adjusted upward to reflect the proportions that go into feeding livestock. The exact coefficients used to make the adjustments are found in Annex V.

The quantities are generally consistent with earlier results for final demand. However, marketings from the farm can go either to final demand or to exports, so there can be

differences. However, most export activities are constrained to actual levels for 1987/88, so this is not generally a source of deviation except for rice. For basmati, the downward sloping export demand function allows for potentially greater exports than actually observed. Also, the export limit for Other Rice has been set at 1,000,000 metric tons, about 400,000 greater than actually observed. These extra volumes were apparently profitable to produce, so quantities of Other Rice were almost 25 percent greater than the actual value and basmati was 15 percent greater. The quantities of the other major crops, sugarcane, cotton fiber, coarse grains and wheat, were acceptable with less than 10 percent deviations from actual values. Fruits and vegetables performed just as well as the major crops. The only products which did not perform as well were oilseeds, which would have been produced at much higher levels than actually occurred during the base year had there been no restrictions imposed on them.

The livestock values are also shown in Table 20. Their quantities were usually quite good with the exception of beef and eggs, whose values were affected because herd sizes were forced into the model at fixed levels. In the case of beef, the herd included animals maintained for beef, bullock labor and breeding purposes. Thus the herd may be too large, so extra beef was produced because there was no cost to providing it. Since eggs were provided by layers, broilers and desi chickens, which were all forced into the solution at fixed herd sizes, the number of eggs exceeded the estimated total for the year. This may have occurred because the model chose rations to optimize the production of chicken meat, which consequently brought in excess eggs, the joint product with chicken meat.

Prices at the farmgate were more variable than quantities and had a less predictable relationship to quantities than did prices at retail. The price-quantity points shown for the different products in this table are best seen as points on the supply curve. Therefore, if the quantity is higher than the actual value, then the price also should be. This stands in contrast to the retail figures, which were affected most by demand relationships, where higher than expected quantities led to lower than expected prices. For rice, sugarcane, coarse grains, oilseeds, fruits and vegetables, this followed. Cotton showed an inverse relationship, where a high quantity was correlated with a relatively low price. However, the actual prices used are for phutti, which still contains cottonseed, rather than for lint alone. The price given from the PASM model is for lint, which would naturally have a higher price because it is the source of most of the value from raw cotton. Pulses also exhibited the same inverse relationship between prices and quantities, for reasons which are not known.

Perhaps the most unacceptable results are for fruits and vegetables, where prices are much too low while quantities are reasonable. Part of this result comes from the fact that retail prices were about 50 percent of actual prices for vegetables; then with marketing margins deducted the farmgate prices became quite low. Raising the elasticities of demand at retail would probably increase the price, but would also increase quantity to some extent. Nonetheless, it is quite remarkable that it is profitable to sell fruits at so low an implicit farmgate price. Most likely this occurs because the scarcest resource is land, which vegetables use efficiently given their high value per hectare. For those farm sizes which use mainly family labor for vegetable production and have relatively high yields, this may be a viable venture even

TABLE 20

NATIONAL RETAIL QUANTITIES DEMANDED AND AVERAGE DOMESTIC PRICES
BASE PASM SIMULATION AND ACTUAL, 1987/88

COMMODITY	PRICES (RS/MT) PASM	PRICES (RS/MT) ACTUAL	PRICES (RS/MT) % PASM OF ACTUAL	QUANTITIES (MT)* PASM	QUANTITIES (MT)* ACTUAL	QUANTITIES (MT)* % PASM OF ACTUAL
CROP PRODUCTS:						
Basmati Rice	5,148	8,250	62.4	797	699	114.0
Other Rice	2,350	3,810	61.7	1,798	1,627	110.5
Coarse Grains	3,138	3,213	97.7	1,055	1,034	102.0
Cotton Textiles	137,747	147,330	93.5	297	283	105.0
Sugar	7,632	8,528	89.5	2,776	2,742	101.2
Pulses	11,337	7,597	149.2	456	565	80.8
Vegetables	2,819	5,280	53.4	3,327	2,957	112.5
Fruit	6,798	7,262	93.6	3,045	3,007	101.3
Wheat Products	3,436	2,593	132.5	9,119	10,261	88.9
LIVESTOCK PRODUCTS:						
Vegetable Ghee	18,516	16,510	112.2	1,120	1,187	94.3
Liquid Oil	19,976	17,000	117.5	53	59	90.2
Beef	4,300	16,910	25.4	836	595	140.5
Milk	5,761	5,985	96.3	13,898	13,406	103.7
Butter	23,909	47,980	49.8	84	65	128.5
Animal Ghee	58,045	49,400	117.5	111	118	94.2
Mutton	43,162	36,710	117.6	480	570	84.2
Chicken Meat	21,586	24,670	87.5	161	152	105.6
Eggs	190	920	20.7	5,234	4,057	129.0

*Except eggs, which are in Rs. Billion

at these quite low prices per unit. This seems particularly persuasive given that the vegetable output was produced on about half the acreage actually required. A similar but less extreme situation exists with respect to fruits.

Input Prices and Quantities Used. The final table in this section, Table 21, compiles selected primal and dual results for major inputs used in the model. These results portray the total use of those inputs relative to actual availabilities along with their implied opportunity costs. A quick caveat concerns the dual prices reported in the table, which are the marginal value products of the inputs or their opportunity costs. The quantities of fertilizer and hired labor are constrained not only by zone but also by season. Therefore, if quantities are particularly tight within a given season, the opportunity cost will be high and the weighted dual price presented in the table will be affected. A future adjustment will be made to allow quantities to move across seasons but not zones, which will moderate the dual prices found in the table. The actual dual prices must be treated with caution at this point (particularly for potash), but it is possible for relative rankings to be seen. Finally, all inputs presented in Table 21 have prices in the objective function, so with excess availability, shadow prices would be equal to the values in the objective function.

The first three parts of Table 21 refer to each type of fertilizer used in the model. Looking first at quantities, it is seen that some excess fertilizer exists for all three types. Nitrogen fertilizer is almost used completely, but there is about 10 percent of phosphates and potash left over. The table also shows variation by region, as almost all nitrogen is used in the Punjab while about a quarter of the available quantity remains in Balochistan. Overall, there were adequate quantities of fertilizer in the base year but the demand in different zones and seasons was not matched exactly to actual values. This led to opportunity costs being greater than observed prices because quantities were restricted by season and zone and could not be transferred to other times or areas.

The extreme example of this issue is found by looking at potash in Balochistan. Of the 210 metric tons of potash available for Balochistan, about 70 MT were available during kharif and 140 MT were provided for rabi. All of the product was used during kharif but 50 MT was left over in rabi. The net result was that only slightly over half the available potash fertilizer was used in that region, as indicated in the table. By allowing the fertilizer to move from one season to another, a small shift in resources would make the dual prices drop considerably. A larger revision would be to allow fertilizer to shift between regions as needed, which would further balance quantities and give a better picture of the imbalances in current fertilizer distribution and production.

The final inputs presented in Table 21 are for hired labor and tractor services. Tractor services are not constrained and are simply given the same price in each region. (Prices however could be varied easily.) As a result, the quantities simply show what the model demands for tractor services, but there is no comparison between actual availabilities and model use. The assumptions made on hired labor led to plenty of that input being available. However, the same problem of seasonal and local scarcities of the input existed prior to making

adjustments in availabilities. These changes are discussed in Annex III. With adequate quantities of hired labor available in all regions except NWFP, the opportunity costs were exactly the prices in the objective function.

Other Information in the Results. The main values in both the dual and primal solution have been included in the preceding tables or in earlier discussions. Yet even more information could be summarized and presented. In the primal solution, most of the activities relate either to acreage, livestock maintenance activities, regional marketing and final demand activities, all of which have been discussed. Other values related to the primal solution which could be presented are home consumption of wheat and rice, the use of family labor (which is in slack in almost all areas), the effects of crop rotation restrictions and the use of different crop products as inputs to livestock rations in each zone. For the dual values, opportunity costs on farmland, family labor, crop rotations and home consumption values could be presented. As indicated these are somewhat more complex to weight because they are associated with each farm size. Nonetheless, interesting additional information could be obtained. The farmyard manure and bullock labor usages have not been complied either, but they generally were in excess. Certain local results vary from this conclusion and might be worth inspecting. Finally, the opportunity costs of livestock animals and ration inputs could be assessed by zone.

TABLE 21

REGIONAL USE AND OPPORTUNITY COSTS OF MAJOR INPUTS,
PASM RESULTS AND ACTUAL, 1987/88
(NUTRIENT TONS)

INPUT TYPE	PRICES (RS/MT) PASM	PRICES (RS/MT) ACTUAL	PRICES (RS/MT) % PASM OF ACTUAL	QUANTITIES (MT)* PASM	QUANTITIES (MT)* ACTUAL	QUANTITIES (MT)* % PASM OF ACTUAL
NITROGEN FERTILIZER						
PUNJAB	17,202	5,783	297.5	856,508	878,901	97.5
SIND	7,334	5,783	126.8	277,130	309,400	89.6
BALOCHISTAN	5,913	5,913	100.0	8,909	11,840	75.2
NWFP	42,404	5,913	717.1	77,919	83,180	93.7
TOTAL or AVERAGE	16,352	5,793	311.4	1,220,466	1,283,321	95.1
PHOSPHATE FERTILIZER						
PUNJAB	4,847	4,847	100.0	260,847	280,306	93.1
SIND	4,847	4,847	100.0	70,067	84,300	83.1
BALOCHISTAN	20,819	4,952	420.4	4,057	4,520	89.8
NWFP	4,952	4,952	100.0	21,831	25,770	84.7
TOTAL or AVERAGE	5,037	4,855	103.7	356,801	394,896	90.4
POTASH FERTILIZER						
PUNJAB	41,837	2,520	1660.2	26,816	28,298	94.8
SIND	91,626	2,520	3635.9	7,754	9,676	80.1
BALOCHISTAN	4,117,102	2,640	155950.8	119	210	56.7
NWFP	167,013	2,640	6326.3	4,040	5,280	76.5
TOTAL or AVERAGE	87,817	2,535	3464.0	38,729	43,464	89.1

TABLE 21

REGIONAL USE AND OPPORTUNITY COSTS OF MAJOR INPUTS,
PASM RESULTS AND ACTUAL, 1987/88
(NUTRIENT TONS)

INPUT TYPE	PRICES (RS/MT) PASM	PRICES (RS/MT) ACTUAL	PRICES (RS/MT) % PASM OF ACTUAL	QUANTITIES (MT)* PASM	QUANTITIES (MT)* ACTUAL	QUANTITIES (MT)* % PASM OF ACTUAL
HIRED LABOR				('000 Man Hours)		
PUNJAB	3,111	3,111	100.0	2,126,886	3,432,038	62.0
SIND	2,778	2,778	100.0	697,049	862,385	80.8
BALOCHISTAN	2,444	2,444	100.0	87,935	168,682	52.1
NWFP	11,528	2,560	450.3	186,160	186,160	100.0
TOTAL or AVERAGE	3,362	3,003	112.0	3,098,031	4,649,265	66.6
TRACTOR SERVICES				('000 Service Hours)		
PUNJAB	67,300	67,300	100.0	100,222	NA	ERR
SIND	67,300	67,300	100.0	32,227	NA	ERR
BALOCHISTAN	67,300	67,300	100.0	2,685	NA	ERR
NWFP	67,300	67,300	100.0	13,205	NA	ERR
TOTAL or AVERAGE	67,300	67,300	100.0	148,339	NA	ERR

3.5 A COMPARISON WITH THE INDUS BASIN MODEL

In order to put the above results in context, it is worth comparing PASM with the Indus Basin Model Revised (IBMR), which is the other model in Pakistan with a similar construction. The acreage solutions of that model, as reported in the January, 1990 report on IBMR, are contained in Table 22 on the following page. What is clear is that the PASM model results are as close to actual acreage as are the IBMR results, and for many commodities they are closer. The Indus Basin model only constrains orchard acreage, while the PASM model constrains about 15% of total acreage. However, the IBMR does not include non-traditional oilseeds, and acreage in that model are roughly constrained to historical acreage in each of the regions. Thus there is little likelihood that the great dominance of oilseeds which occurs in PASM could occur in IBMR. Those acreage might have to be constrained in IBMR were it a national model with endogenous import/export values and with the possibility of producing to substitute for the large import costs of edible oils.

The import and export values are only indirectly accounted for in the IBMR, while in PASM they are central determinants of how the model reacts. Thus those values cannot be compared. An advantage of the IBMR is that livestock is endogenous, while it is fixed in PASM at actual levels. However, livestock only enters the IBMR at 60-65% of true values. Without constraining livestock, their fodder acreage is low, as it was in the PASM model. The IBMR indicates that the current tightness of cropland biases against livestock products. This may well be true in PASM as well, because including livestock at their actual levels makes the solution of PASM arduous. The structure of PASM allows livestock to be fed on different rations, thereby paving the way to introduce modern intensive feeding operations. It also makes sure that the actual choices of the model take into account adequately the requirements of the livestock sector.

Table 22

1987-88 CROPPING PATTERN MODEL SIMULATION

VS

ESTIMATED ACTUAL FOR THE INDUS BASIN MODEL REVISED (IBMR)

(000's Acres)

	Punjab			Sind			Pakistan		
	Model	Actual	% Simulated /Actual	Model	Actual	% Simulated /Actual	Model	Actual	% Simulated /Actual
BASMATI	2188.7	2001	109.38				2188.7	2001	109.38
IRRI	415.8	620	67.06	1534.7	1491	102.93	1950.5	2111	92.40
COTTON	7027	4782	146.95	1654.8	1555	106.42	8681.8	6337	137.00
RABI-FODDER	1618.4	2513	64.40	487.6	415	117.49	2174.5	2975	73.09
GRAM	1225	1586	77.24	215.6	218	98.90	1537.6	1936	79.42
MAIZE	302.5	101	299.50	1.8			501.7	179	280.28
MUS+RAPESEED	364.9	385	94.78	209.9	225	93.29	609.9	662	92.13
KHARIF-FODDER	1037.9	2732	37.99	210.5	142	148.24	1300.8	2888	45.04
SUGARCANE	927.8	1396	66.46	489.6	542	90.33	1583.3	2081	76.08
WHEAT	11690.8	12321	94.89	2595	2616	99.20	14508.8	15161	95.70
ORCHARDS	691	691	100.00	200	200	100.00	918	918	100.00
POTATOES	123.6	113	109.38	39.9	38	105.00	172.6	159	108.55
ONIONS	98	89	110.11	33.1	29	114.14	136.9	124	110.40
CHILIES	146.1	123	118.78	40.6	41	99.02	197.6	173	114.22
TOTAL:	27857.5	29453	94.58	7713.1	7512	102.68	36462.7	35704	102.12

IV. CONCLUDING COMMENTS

This document has presented the structure and results of the Pakistan Agricultural Sector Model (PASM), a linear programming model designed to evaluate the impacts of technological, economic and policy changes in the agricultural sector and in agribusinesses selling to and buying from the agricultural sector. Many of the results have been quite good because acreages and quantities produced are close to actual values for most crops, livestock demand for rations are reasonable, and the usage and scarcity values for most inputs seem to be in line with actual circumstances. However, there is still room for improvement and expansion of the model. Some of these efforts are relatively modest and will be done in the near future, while others may require substantial additional effort, which must await further interest and time commitment before they are undertaken.

Perhaps the central challenge in making this type of model reflect actual patterns of production and consumption is to keep it from excessively specializing in production. Because the model looks for the best location and technology to produce each product, it is hyper-efficient in the use of resources and is prone to put all rice in the Sind or all wheat in the Punjab, for example. Furthermore, if imports and exports are not constrained, even greater specialization could occur, in that most of the economy ends up devoted to producing for export and most goods are imported. Finally, there is also a tendency towards excessive specialization by farm size, so crops are produced by a small subset of the farm types which actually exist.

This problem has been handled with some degree of success at the national and regional levels. By specifying limits on domestic demand, exports, and imports a wider variety of crops and livestock are produced and consumed. Also, specialization has been reduced by the inclusion of home consumption activities and by the fact that each zone must support its own livestock on rations produced in that zone. The model has been less successful in reducing specialization at the zonal and farm level. Thus the averages are decent, but the detailed performance could be improved. (This in some ways reflects the purpose of the model, which is not to make every farm size perform correctly but to show the larger tendencies as changes in economic fundamentals and policies arise.) Several additional avenues for enhancing the model are discussed in the following paragraphs.

A number of minor changes will be made to the model in the near future. Several export activities, primarily in rice, will be changed or bring acreages closer to actual values. Currently, exports of Irri and basmati rice are too high. For Irri, the reason is that the limit is placed above the current level, and for basmati, the downward sloping demand curve allows a range of greater exports to be chosen. With these values being above average, all other acreages and quantities are affected.

Other relatively small changes will be made soon as well. Quantities of fertilizer will be allowed to move from season to season, thereby reducing their average opportunity costs. Edible oil produced from traditional oilseeds will also be separated from edible oil coming from non-traditional oilseeds and cottonseed in final demand, which should limit acreage in the former

commodity and reduce the tendency of the model to over-produce oilseeds. Changing the elasticities of retail demand may increase average prices of rice at retail, which are currently too low. The NWFP region will also be re-specified to separate out irrigated and unirrigated acreage, which should affect acreages of wheat and pulses and make them more consistent with actual values.

Several larger efforts are also being contemplated, and should improve the model or add further insights from it. One major effort would be to create regional supply and demand curves, so that the costs of transporting from surplus to deficit areas is included. This should help improve the pattern of production and input use, and first, just major crops could be adjusted in the model to see if improvements are significant. For many analyses, such as location of fertilizer plants or processing facilities, or policy changes in wheat marketing, having a model which functioned well at the zonal level would add realism to the conclusions. A related addition would be to limit capacity for processing agricultural products within each zone so that products would not be produced excessively in the wrong regions. A final large effort, which is being undertaken in a Ph.D dissertation at Colorado State, would be to review the livestock ration demand coefficients and perhaps put them in terms of digestible protein and total digestible nutrients. This might limit the excessive production of sugarcane, for instance, which supplies green matter relatively efficiently in the current specification of the model, but may not add enough actual nutrients to be used with more precise coefficients. This re-specification might also make it unnecessary to constrain kharif fodder acreage.

All of the adjustments above will be made to the LINDO version of the model, as it appears to be the most attractive software to use for the near future. In addition to running more quickly on available 386 machines, Hyper Lindo can apparently handle up to 2,000 rows and 4,000 columns, which would, among other things, allow the model to solve the dual and show impacts of government programs which impose price restrictions. This version of the model can also accommodate any of the larger changes contemplated above. Finally, supporting spreadsheets will be created to make the job of changing coefficients and summarizing output in Lindo less onerous. With these software additions, substantial revisions of the model will be easy to make and a wide variety of simulations and revisions can be handled with modest effort.

REFERENCES

(Davies, 1989, and Ali, 1990)

Indus Basin Model Revised (IBMR)

Hazel and Norton, Mathematical Programming in Agriculture, and in the Turkish Agricultural Sector Model (TASM), also designed by Roger Norton among others.

PAKISTAN AGRICULTURAL SECTOR MODEL

ANNEXES I - VII

Annexes I - VII

The following sections describe the details of the data used in the PASM model and some of the basic equations as well. The annexes are grouped by the components of the model -- **the objective function, the right-hand side values, and the coefficients**. The objective function includes three main sets of values, the crop-specific costs associated with production activities, the marketing margins between the retail and farmgate prices, and the consumer surplus values associated with the final demand values. These are contained in Annexes I - II. The right hand-side values include the amount of land, water, fertilizer, and hired and family labor available to each of the farm sizes. It also includes the market surplus functions which determine how much production is undertaken to supply farm household consumption needs. These are given in Annex III. The next two annexes describe the major groups of coefficients that make up the tableau of the model. First the crop coefficients, which have generally been taken from the EAN Farm Income Estimates, are presented in Annex IV. These are followed by Annex V, which presents the construction of the coefficients which model the livestock sector in the model. These annexes have been written by Mubarik Ali and Faiz Mohammed. The description of the variable names in the model are given in Annex VI. Because these names are compact descriptors of both the activities and the constraints equations in the model, knowledge of this annex is important for the frequent user to be able to change and evaluate PASM efficiently. The final annex gives the exact formulas for each of the equations in the model.

ANNEX I

CROP-SPECIFIC PRODUCTION COSTS

This annex presents five costs which are included in the objective function in rather than as supply-demand balance rows or resource restrictions. They are included in the objective function because they are specific to each crop, so that other formulations would create a much larger model.

Crop-Specific Costs of Production

Each column which stands for a production activity is identified with a particular crop, size of farm and zone. Thus the label PM4RIO would indicate the production of Other Rice by a medium farm (M) in Zone 4 (Sind Rice zone). (Annex VI gives details on the names of columns and rows.) Each of these activities require fertilizer, land, water, tractor services, etc., which are included as constraint equations denoting resource restrictions. However, each crop activity also has a set of costs which are specific to that crop. Were these to be entered into the model as individual resource restrictions, there would have to be a separate equation for each crop, size of farm and zone. For example, adding a seed supply-demand balance row or resource restriction for all crops would increase the model by up to nineteen rows for each size of farm and zone, or by 399 rows in total. Of course, not all crops would need to be included, but there are also other types of crop-specific costs that could be considered besides seed. Thus these values are included in the objective function to make sure that their costs are accounted for, but they are summarized as one expression to economize on the size of the model. They are also not usually limited in quantity because there are no resource restrictions associated with them. The exception is water rate, which is priced according to each crop and zone, but is also restricted in availability.

There are five costs currently included in the values placed in the objective function -- seed, pesticides, thresher costs, interest on working capital, artisan services, and water rate. The following 24 tables show these costs for all crops in each size of farm and zone in the model. They are presented as rupees per hectare for ease of interpretation. The values are converted to Crore Rupees per thousand hectares when entered into the objective function. While these are composite values in the model, the separate numbers shown below are also contained in a spreadsheet called CSCOSTS.WK1. With a moderate extension, this spreadsheet could be set up so that an easy revision of each cost could be made in order to facilitate various simulations. Also, if one item were to be taken out of the list and entered as constraint equations, all other values in the objective function would change. Thus it is advisable to set up a format which allows for easy revision.

TABLE A1.1: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB RICE, ZONE 1, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	37.9	11.6	0.0	152.5	44.9	158.1	405.1
Other Rice	22.8	11.6	0.0	141.1	32.5	158.1	366.2
Coarse Grains	89.3	20.3	0.0	76.4	11.2	47.4	244.6
Cotton (3-Pickings)	123.7	271.8	0.0	139.4	44.9	83.0	662.8
Cotton (4-Pickings)	123.7	271.8	0.0	139.4	44.9	83.0	662.8
Sugarcane	1,017.3	32.5	0.0	119.8	22.4	158.1	1,350.3
Traditional Oilseeds*	323.2	2.3	0.0	87.1	22.4	0.0	435.0
Non-Traditional Oilseeds	46.9	2.3	0.0	87.1	22.4	0.0	158.8
Pulses (Mung)**	99.5	0.0	0.0	30.9	22.4	0.0	152.8
Vegetables (Chillies)**	13.8	92.8	0.0	170.4	33.7	0.0	310.6
Kharif Fodder	246.1	0.0	0.0	92.7	0.0	49.4	388.2
RABI:							
Wheat	220.4	0.0	101.4	54.9	44.9	53.4	475.0
Late Wheat	220.4	0.0	101.4	54.9	44.9	53.4	475.0
Barley	209.5	0.0	0.0	42.3	0.0	0.0	251.7
Pulses (Gram)**	277.9	1.7	0.0	45.2	0.0	39.5	364.3
High Value Crops (Potato)**	12,721.5	175.7	0.0	914.8	0.0	102.8	13,914.8
Traditional Oilseeds***	30.1	2.3	0.0	43.0	0.0	58.1	133.5
Non-Traditional Oilseeds***	46.9	2.3	0.0	43.0	0.0	58.1	150.2
Rabi Fodder	150.6	2.3	0.0	75.9	0.0	49.4	278.2

Source: EAN Farm Income Estimates

TABLE A1.2: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB RICE, ZONE 1, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	32.8	11.6	0.0	160.2	44.9	158.1	407.6
Other Rice	27.3	11.6	0.0	202.5	32.5	158.1	432.2
Coarse Grains	89.3	20.3	0.0	93.0	11.2	47.4	261.2
Cotton (3-Pickings)	123.7	271.8	0.0	163.6	44.9	83.0	687.0
Cotton (4-Pickings)	123.7	271.8	0.0	163.6	44.9	83.0	687.0
Sugarcane	1,092.7	32.5	0.0	251.9	22.4	158.1	1,557.7
Traditional Oilseeds*	323.2	2.3	0.0	143.7	15.7	0.0	484.9
Non-Traditional Oilseeds	46.9	2.3	0.0	143.7	15.7	0.0	208.6
Pulses (Mung)**	99.5	0.0	0.0	43.2	15.7	0.0	158.4
Vegetables (Chillies)**	13.8	92.8	0.0	196.8	33.7	0.0	337.0
Kharif Fodder	246.1	0.0	0.0	137.2	0.0	49.4	432.8
RABI:							
Wheat	225.4	0.0	81.4	81.0	44.9	53.4	486.0
Late Wheat	225.4	0.0	81.4	81.0	44.9	53.4	486.0
Barley	209.5	0.0	0.0	49.4	0.0	0.0	258.9
Pulses (Gram)**	277.9	1.7	0.0	56.8	0.0	39.5	376.0
High Value Crops (Potato)**	12,721.5	165.0	0.0	963.8	0.0	102.8	13,953.1
Traditional Oilseeds***	30.1	2.3	0.0	58.2	0.0	58.1	148.7
Non-Traditional Oilseeds***	46.9	2.3	0.0	58.2	0.0	58.1	165.5
Rabi Fodder	150.6	2.3	0.0	120.4	0.0	49.4	322.7

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.3: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB RICE, ZONE 1, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	32.8	11.6	44.9	202.1	44.9	158.1	494.5
Other Rice	27.3	11.6	0.0	203.5	32.5	158.1	433.2
Coarse Grains	89.3	20.3	0.0	111.5	11.2	47.4	279.7
Cotton (3-Pickings)	123.7	271.8	0.0	181.7	44.9	83.0	705.1
Cotton (4-Pickings)	123.7	271.8	0.0	181.7	44.9	83.0	705.1
Sugarcane	1,092.7	32.5	0.0	323.2	22.4	158.1	1,628.9
Traditional Oilseeds*	323.2	2.3	0.0	222.1	11.2	0.0	558.8
Non-Traditional Oilseeds	46.9	2.3	0.0	222.1	11.2	0.0	282.5
Pulses (Mung)**	99.5	0.0	0.0	57.6	11.2	0.0	168.3
Vegetables (Chillies)**	13.8	92.8	0.0	223.8	33.7	0.0	364.0
Kharif Fodder	246.1	0.0	0.0	216.9	0.0	49.4	512.4
RABI:							
Wheat	225.4	0.0	61.4	104.7	44.9	53.4	489.7
Late Wheat	225.4	0.0	61.4	104.7	44.9	53.4	489.7
Barley	209.5	0.0	0.0	58.0	0.0	0.0	267.4
Pulses (Gram)**	277.9	1.7	0.0	67.9	0.0	39.5	387.1
High Value Crops (Potato)**	12,721.5	10.7	0.0	1,001.6	0.0	102.8	13,836.6
Traditional Oilseeds***	30.1	2.3	0.0	72.4	0.0	58.1	162.9
Non-Traditional Oilseeds***	46.9	2.3	0.0	72.4	0.0	58.1	179.7
Rabi Fodder	150.6	2.3	0.0	200.1	0.0	49.4	402.4

Source: EAN Farm Income Estimates

TABLE AI.4: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB SUGARCANE, ZONE 2, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	62.3	11.6	0.0	74.8	46.3	63.3	258.3
Other Rice	25.0	11.6	0.0	113.0	32.5	158.1	340.4
Coarse Grains	64.0	20.3	0.0	89.6	11.2	47.4	232.5
Cotton (3-Pickings)	92.9	271.8	0.0	138.1	44.9	83.0	630.7
Cotton (4-Pickings)	92.9	271.8	0.0	138.1	44.9	83.0	630.7
Sugarcane	1,189.3	32.5	0.0	184.5	22.4	158.1	1,586.9
Traditional Oilseeds*	236.5	2.3	0.0	85.1	22.4	0.0	346.3
Non-Traditional Oilseeds	46.9	2.3	0.0	85.1	22.4	0.0	156.7
Pulses (Mung)**	92.9	0.0	0.0	30.5	22.4	0.0	145.8
Vegetables (Chillies)**	12.2	92.8	0.0	186.6	33.7	0.0	325.2
Kharif Fodder	202.8	0.0	0.0	93.3	0.0	49.4	345.5
RABI:							
Wheat	221.9	0.0	103.2	83.4	44.9	53.4	506.8
Late Wheat	221.9	0.0	103.2	83.4	44.9	53.4	506.8
Barley	209.5	0.0	0.0	42.5	0.0	0.0	251.9
Pulses (Gram)**	364.6	1.7	0.0	50.4	0.0	39.5	456.2
High Value Crops (Potato)**	11,210.6	175.7	0.0	825.6	0.0	102.8	12,314.6
Traditional Oilseeds***	30.1	2.3	0.0	43.5	0.0	58.1	133.9
Non-Traditional Oilseeds***	46.9	2.3	0.0	43.5	0.0	58.1	150.7
Rabi Fodder	150.6	2.3	0.0	76.3	0.0	49.4	278.6

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.5: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB SUGARCANE, ZONE 2, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	47.6	11.6	0.0	117.9	29.4	87.7	294.3
Other Rice	25.0	11.6	0.0	145.8	32.5	158.1	373.2
Coarse Grains	105.2	20.3	0.0	118.9	11.2	47.4	303.1
Cotton (3-Pickings)	101.3	271.8	0.0	257.0	44.9	83.0	758.0
Cotton (4-Pickings)	101.3	271.8	0.0	257.0	44.9	83.0	758.0
Sugarcane	1,293.7	32.5	0.0	299.0	22.4	158.1	1,805.7
Traditional Oilseeds*	236.5	2.3	0.0	141.7	15.7	0.0	396.2
Non-Traditional Oilseeds	46.9	2.3	0.0	141.7	15.7	0.0	206.5
Pulses (Mung)**	92.9	0.0	0.0	42.8	15.7	0.0	151.4
Vegetables (Chillies)**	12.2	92.8	0.0	212.9	33.7	0.0	351.6
Kharif Fodder	202.8	0.0	0.0	137.8	0.0	49.4	390.0
RABI:							
Wheat	241.4	0.0	110.7	123.9	44.9	53.4	574.3
Late Wheat	241.4	0.0	110.7	123.9	44.9	53.4	574.3
Barley	209.5	0.0	0.0	49.4	0.0	0.0	258.9
Pulses (Gram)**	364.6	1.7	0.0	62.0	0.0	39.5	467.8
High Value Crops (Potato)**	11,210.6	165.0	0.0	874.6	0.0	102.8	12,353.0
Traditional Oilseeds***	30.1	2.3	0.0	58.7	0.0	58.1	149.1
Non-Traditional Oilseeds***	46.9	2.3	0.0	58.7	0.0	58.1	165.9
Rabi Fodder	150.6	2.3	0.0	120.8	0.0	49.4	323.1

Source: EAN Farm Income Estimates

TABLE AI.6: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB SUGARCANE, ZONE 2, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	55.0	11.6	0.0	135.9	15.8	87.7	306.1
Other Rice	25.0	11.6	0.0	176.2	32.5	158.1	403.6
Coarse Grains	101.0	20.3	0.0	146.0	11.2	47.4	326.0
Cotton (3-Pickings)	120.3	271.8	0.0	365.9	44.9	83.0	885.9
Cotton (4-Pickings)	120.3	271.8	0.0	365.9	44.9	83.0	885.9
Sugarcane	1,270.7	32.5	0.0	390.3	22.4	158.1	1,874.1
Traditional Oilseeds*	236.5	2.3	0.0	220.0	11.2	0.0	470.1
Non-Traditional Oilseeds	46.9	2.3	0.0	220.0	11.2	0.0	280.4
Pulses (Mung)**	92.9	0.0	0.0	57.2	11.2	0.0	161.3
Vegetables (Chillies)**	12.2	92.8	0.0	239.0	33.7	0.0	377.6
Kharif Fodder	202.8	0.0	0.0	217.5	0.0	49.4	469.7
RABI:							
Wheat	225.9	0.0	76.9	127.1	44.9	53.4	528.2
Late Wheat	225.9	0.0	76.9	127.1	44.9	53.4	528.2
Barley	209.5	0.0	0.0	57.8	0.0	0.0	267.2
Pulses (Gram)**	364.6	1.7	0.0	73.1	0.0	39.5	478.9
High Value Crops (Potato)**	11,210.6	10.7	0.0	912.4	0.0	102.8	12,236.5
Traditional Oilseeds***	30.1	2.3	0.0	72.9	0.0	58.1	163.3
Non-Traditional Oilseeds***	46.9	2.3	0.0	72.9	0.0	58.1	180.1
Rabi Fodder	150.6	2.3	0.0	200.4	0.0	49.4	402.7

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.7 PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB COTTON, ZONE 3, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	58.5	11.6	0.0	114.8	35.2	63.3	283.3
Other Rice	24.5	11.6	0.0	110.5	32.5	158.1	337.3
Coarse Grains	207.3	20.3	0.0	48.1	0.0	0.0	275.6
Cotton (3-Pickings)	108.2	271.8	0.0	386.9	0.0	0.0	766.9
Cotton (4-Pickings)	108.2	271.8	0.0	386.9	0.0	0.0	766.9
Sugarcane	1,111.2	32.5	0.0	469.8	0.0	0.0	1,613.6
Traditional Oilseeds*	235.5	2.3	0.0	87.8	22.4	0.0	348.0
Non-Traditional Oilseeds	46.9	2.3	0.0	87.8	22.4	0.0	159.4
Pulses (Mung)**	102.9	0.0	0.0	31.1	22.4	0.0	156.5
Vegetables (Chillies)**	12.7	92.8	0.0	170.3	33.7	0.0	309.5
Kharif Fodder	202.8	0.0	0.0	90.0	0.0	49.4	342.2
RABI:							
Wheat	243.5	0.0	98.7	116.1	44.9	53.4	556.6
Late Wheat	243.5	0.0	98.7	116.1	44.9	53.4	556.6
Barley	209.5	0.0	0.0	42.4	0.0	0.0	251.8
Pulses (Gram)**	330.8	1.7	0.0	48.3	0.0	39.5	420.4
High Value Crops (Potato)**	11,653.1	175.7	0.0	846.3	0.0	102.8	12,777.9
Traditional Oilseeds***	28.7	2.3	0.0	43.1	0.0	58.1	132.2
Non-Traditional Oilseeds***	46.9	2.3	0.0	43.1	0.0	58.1	150.4
Rabi Fodder	150.6	2.3	0.0	76.1	0.0	49.4	278.4

Source: EAN Farm Income Estimates

TABLE AI.8: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB COTTON, ZONE 3, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	62.0	11.6	0.0	160.2	19.1	81.6	334.5
Other Rice	32.7	11.6	0.0	95.3	32.5	158.1	330.3
Coarse Grains	84.2	20.3	133.4	137.0	0.0	0.0	374.9
Cotton (3-Pickings)	120.3	271.8	0.0	291.0	0.0	0.0	683.0
Cotton (4-Pickings)	120.3	271.8	0.0	291.0	0.0	0.0	683.0
Sugarcane	1,141.5	32.5	0.0	360.2	0.0	0.0	1,534.2
Traditional Oilseeds*	235.5	2.3	0.0	144.3	15.7	0.0	397.9
Non-Traditional Oilseeds	46.9	2.3	0.0	144.3	15.7	0.0	209.2
Pulses (Mung)**	102.9	0.0	0.0	43.4	15.7	0.0	162.1
Vegetables (Chillies)**	12.7	92.8	0.0	196.7	33.7	0.0	335.8
Kharif Fodder	202.8	0.0	0.0	134.6	0.0	49.4	386.8
RABI:							
Wheat	244.6	0.0	74.3	114.5	44.9	53.4	531.7
Late Wheat	244.6	0.0	74.3	114.5	44.9	53.4	531.7
Barley	209.5	0.0	0.0	49.6	0.0	0.0	259.0
Pulses (Gram)**	330.8	1.7	0.0	60.0	0.0	39.5	432.1
High Value Crops (Potato)**	11,653.1	165.0	0.0	881.8	0.0	102.8	12,802.7
Traditional Oilseeds***	28.7	2.3	0.0	58.3	0.0	58.1	147.4
Non-Traditional Oilseeds***	46.9	2.3	0.0	58.3	0.0	58.1	165.6
Rabi Fodder	150.6	2.3	0.0	120.6	0.0	49.4	322.9

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.9: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS PUNJAB COTTON, ZONE 3, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	51.6	11.6	0.0	131.7	16.8	99.8	311.7
Other Rice	24.5	11.6	0.0	173.7	32.5	158.1	400.5
Coarse Grains	129.5	20.3	0.0	63.7	0.0	0.0	213.5
Cotton (3-Pickings)	139.9	271.8	0.0	310.1	0.0	0.0	721.8
Cotton (4-Pickings)	139.9	271.8	0.0	310.1	0.0	0.0	721.8
Sugarcane	1,082.3	32.5	0.0	417.6	0.0	0.0	1,532.4
Traditional Oilseeds*	235.5	2.3	0.0	222.7	11.2	0.0	471.8
Non-Traditional Oilseeds	46.9	2.3	0.0	222.7	11.2	0.0	283.1
Pulses (Mung)**	102.9	0.0	0.0	57.8	11.2	0.0	172.0
Vegetables (Chillies)**	12.7	92.8	0.0	218.3	33.7	0.0	357.4
Kharif Fodder	202.8	0.0	0.0	214.2	0.0	49.4	466.4
RABI:							
Wheat	250.9	0.0	75.6	132.4	44.9	53.4	557.1
Late Wheat	250.9	0.0	75.6	132.4	44.9	53.4	557.1
Barley	209.5	0.0	0.0	58.1	0.0	0.0	267.6
Pulses (Gram)**	330.8	1.7	0.0	71.1	0.0	39.5	443.2
High Value Crops (Potato)**	11,653.1	10.7	0.0	874.0	0.0	102.8	12,640.6
Traditional Oilseeds***	28.7	2.3	0.0	72.5	0.0	58.1	161.6
Non-Traditional Oilseeds***	46.9	2.3	0.0	72.5	0.0	58.1	179.8
Rabi Fodder	150.6	2.3	0.0	200.2	0.0	49.4	402.5

Source: EAN Farm Income Estimates

TABLE AI.10: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND RICE, ZONE 4, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	40.9	24.3	0.0	121.1	0.0	158.1	344.4
Coarse Grains	84.6	0.0	0.0	58.0	0.0	47.4	190.0
Cotton (3-Pickings)	274.5	628.1	0.0	139.7	0.0	83.0	1,125.3
Cotton (4-Pickings)	274.5	628.1	0.0	139.7	0.0	83.0	1,125.3
Sugarcane	1,041.4	84.1	0.0	111.3	0.0	158.1	1,395.1
Traditional Oilseeds*	213.5	39.0	0.0	77.8	0.0	0.0	330.3
Non-Traditional Oilseeds	46.9	39.0	0.0	77.8	0.0	0.0	163.8
Pulses (Mung)**	78.6	0.0	0.0	29.6	0.0	0.0	108.2
Vegetables (Chillies)**	64.7	543.4	0.0	131.4	0.0	0.0	739.5
Kharif Fodder	103.3	0.0	0.0	71.0	0.0	49.4	223.7
RABI:							
Wheat	192.1	0.0	101.4	135.5	44.9	53.4	527.2
Late Wheat	192.1	0.0	101.4	135.5	44.9	53.4	527.2
Barley	186.3	0.0	0.0	61.1	0.0	0.0	247.4
Pulses (Gram)**	236.6	0.0	0.0	59.6	47.1	39.5	382.8
High Value Crops (Potato)**	11,478.3	200.9	0.0	1,050.9	0.0	102.8	12,832.9
Traditional Oilseeds***	10.7	39.0	0.0	124.6	0.0	58.1	232.4
Non-Traditional Oilseeds***	46.9	39.0	0.0	124.6	0.0	58.1	268.6
Rabi Fodder	53.7	39.0	0.0	125.8	0.0	49.4	267.9

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.11: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND RICE, ZONE 4, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	49.0	24.3	0.0	194.6	0.0	158.1	426.1
Coarse Grains	84.6	0.0	0.0	74.6	0.0	47.4	206.6
Cotton (3-Pickings)	274.5	628.1	0.0	163.9	0.0	83.0	1,149.4
Cotton (4-Pickings)	274.5	628.1	0.0	163.9	0.0	83.0	1,149.4
Sugarcane	1,118.6	84.1	0.0	229.5	0.0	158.1	1,590.3
Traditional Oilseeds*	213.5	39.0	0.0	134.4	0.0	0.0	386.9
Non-Traditional Oilseeds	46.9	39.0	0.0	134.4	0.0	0.0	220.4
Pulses (Mung)**	78.6	0.0	0.0	42.0	0.0	0.0	120.6
Vegetables (Chillies)**	64.7	543.4	0.0	157.8	0.0	0.0	765.9
Kharif Fodder	103.3	0.0	0.0	115.5	0.0	49.4	268.2
RABI:							
Wheat	196.4	0.0	81.4	159.8	44.9	53.4	535.8
Late Wheat	196.4	0.0	81.4	159.8	44.9	53.4	535.8
Barley	186.3	0.0	0.0	74.4	0.0	0.0	260.7
Pulses (Gram)**	236.6	0.0	0.0	71.2	47.1	39.5	394.5
High Value Crops (Potato)**	11,478.3	209.2	0.0	1,101.1	0.0	102.8	12,891.4
Traditional Oilseeds***	10.7	39.0	0.0	139.8	0.0	58.1	247.6
Non-Traditional Oilseeds***	46.9	39.0	0.0	139.8	0.0	58.1	283.8
Rabi Fodder	53.7	39.0	0.0	170.3	0.0	49.4	312.5

Source: EAN Farm Income Estimates

TABLE AI.12: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND RICE, ZONE 4, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	49.0	24.3	0.0	172.9	0.0	158.1	404.4
Coarse Grains	84.6	0.0	0.0	93.0	0.0	47.4	225.0
Cotton (3-Pickings)	274.5	628.1	0.0	182.0	0.0	83.0	1,167.5
Cotton (4-Pickings)	274.5	628.1	0.0	182.0	0.0	83.0	1,167.5
Sugarcane	1,118.6	84.1	0.0	301.8	0.0	158.1	1,662.7
Traditional Oilseeds*	213.5	39.0	0.0	212.8	0.0	0.0	465.3
Non-Traditional Oilseeds	46.9	39.0	0.0	212.8	0.0	0.0	298.7
Pulses (Mung)**	78.6	0.0	0.0	56.4	0.0	0.0	135.0
Vegetables (Chillies)**	64.7	543.4	0.0	185.2	0.0	0.0	793.3
Kharif Fodder	103.3	0.0	0.0	195.2	0.0	49.4	347.9
RABI:							
Wheat	196.4	0.0	61.4	197.5	44.9	53.4	553.5
Late Wheat	196.4	0.0	61.4	197.5	44.9	53.4	553.5
Barley	186.3	0.0	0.0	87.0	0.0	0.0	273.3
Pulses (Gram)**	236.6	0.0	0.0	82.3	47.1	39.5	405.6
High Value Crops (Potato)**	11,478.3	0.0	0.0	1,135.5	0.0	102.8	12,716.7
Traditional Oilseeds***	10.7	39.0	0.0	154.0	0.0	58.1	261.8
Non-Traditional Oilseeds***	46.9	39.0	0.0	154.0	0.0	58.1	298.0
Rabi Fodder	53.7	39.0	0.0	249.9	0.0	49.4	392.1

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.13: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND COTTON, ZONE 5, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	24.8	24.3	0.0	102.6	0.0	158.1	309.9
Coarse Grains	0.0	0.0	0.0	18.5	0.0	0.0	18.5
Cotton (3-Pickings)	227.5	628.1	0.0	391.0	0.0	0.0	1,246.5
Cotton (4-Pickings)	227.5	628.1	0.0	391.0	0.0	0.0	1,246.5
Sugarcane	1,108.9	84.1	0.0	446.4	0.0	0.0	1,639.4
Traditional Oilseeds*	273.5	39.0	0.0	90.2	0.0	0.0	402.7
Non-Traditional Oilseeds	46.9	39.0	0.0	90.2	0.0	0.0	176.1
Pulses (Mung)**	75.8	0.0	0.0	29.5	0.0	0.0	105.2
Vegetables (Chillies)**	66.3	543.4	0.0	161.2	0.0	0.0	770.9
Kharif Fodder	96.8	0.0	0.0	76.1	0.0	49.4	222.4
RABI:							
Wheat	239.7	0.0	98.7	141.1	44.9	53.4	577.8
Late Wheat	239.7	0.0	98.7	141.1	44.9	53.4	577.8
Barley	155.4	0.0	0.0	42.4	0.0	0.0	197.8
Pulses (Gram)**	213.0	0.0	0.0	43.8	47.1	39.5	343.5
High Value Crops (Potato)**	202.6	200.9	0.0	199.3	0.0	102.8	705.6
Traditional Oilseeds***	4.4	39.0	0.0	56.6	0.0	58.1	158.0
Non-Traditional Oilseeds***	46.9	39.0	0.0	56.6	0.0	58.1	200.6
Rabi Fodder	21.8	39.0	0.0	79.1	0.0	49.4	189.4

Source: EAN Farm Income Estimates

TABLE AI.14: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND COTTON, ZONE 5, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	33.1	24.3	0.0	96.1	0.0	158.1	311.6
Coarse Grains	0.0	0.0	133.4	103.3	0.0	0.0	236.7
Cotton (3-Pickings)	252.8	628.1	0.0	292.9	0.0	0.0	1,173.8
Cotton (4-Pickings)	252.8	628.1	0.0	292.9	0.0	0.0	1,173.8
Sugarcane	1,139.1	84.1	0.0	327.3	0.0	0.0	1,550.6
Traditional Oilseeds*	273.5	39.0	0.0	146.8	0.0	0.0	459.3
Non-Traditional Oilseeds	46.9	39.0	0.0	146.8	0.0	0.0	232.7
Pulses (Mung)**	75.8	0.0	0.0	41.8	0.0	0.0	117.6
Vegetables (Chillies)**	66.3	543.4	0.0	187.5	0.0	0.0	797.2
Kharif Fodder	96.8	0.0	0.0	120.7	0.0	49.4	266.9
RABI:							
Wheat	240.7	0.0	74.3	144.6	44.9	53.4	557.8
Late Wheat	240.7	0.0	74.3	144.6	44.9	53.4	557.8
Barley	155.4	0.0	0.0	50.6	0.0	0.0	206.0
Pulses (Gram)**	213.0	0.0	0.0	55.4	47.1	39.5	355.1
High Value Crops (Potato)**	183.3	209.2	0.0	241.8	0.0	102.8	737.1
Traditional Oilseeds***	4.4	39.0	0.0	71.8	0.0	58.1	173.3
Non-Traditional Oilseeds***	46.9	39.0	0.0	71.8	0.0	58.1	215.8
Rabi Fodder	21.8	39.0	0.0	123.6	0.0	49.4	233.9

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

TABLE AI.15: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS SIND COTTON, ZONE 5, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Other Rice	24.8	24.3	0.0	165.8	0.0	158.1	373.0
Coarse Grains	0.0	0.0	0.0	42.6	0.0	0.0	42.6
Cotton (3-Pickings)	294.0	628.1	0.0	309.2	0.0	0.0	1,231.3
Cotton (4-Pickings)	294.0	628.1	0.0	309.2	0.0	0.0	1,231.3
Sugarcane	1,080.0	84.1	0.0	377.7	0.0	0.0	1,541.8
Traditional Oilseeds*	273.5	39.0	0.0	225.2	0.0	0.0	537.6
Non-Traditional Oilseeds	46.9	39.0	0.0	225.2	0.0	0.0	311.1
Pulses (Mung)**	75.8	0.0	0.0	56.2	0.0	0.0	132.0
Vegetables (Chillies)**	66.3	543.4	0.0	208.2	0.0	0.0	817.9
Kharif Fodder	96.8	0.0	0.0	200.3	0.0	49.4	346.5
RABI:							
Wheat	246.9	0.0	75.6	163.1	44.9	53.4	583.9
Late Wheat	246.9	0.0	75.6	163.1	44.9	53.4	583.9
Barley	155.4	0.0	0.0	59.8	0.0	0.0	215.2
Pulses (Gram)**	213.0	0.0	0.0	66.5	47.1	39.5	366.2
High Value Crops (Potato)**	152.1	0.0	0.0	227.1	0.0	102.8	482.0
Traditional Oilseeds***	4.4	39.0	0.0	85.0	0.0	58.1	187.5
Non-Traditional Oilseeds***	46.9	39.0	0.0	86.0	0.0	58.1	230.0
Rabi Fodder	21.8	39.0	0.0	203.3	0.0	49.4	313.5

Source: EAN Farm Income Estimates

TABLE AI.16: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS BALUCHISTAN, ZONE 6, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	21.0	13.2	0.0	96.5	0.0	91.2	221.8
Other Rice	21.3	13.2	0.0	106.2	32.6	91.2	264.4
Coarse Grains	135.3	22.3	0.0	33.3	0.0	21.3	212.3
Cotton (3-Pickings)	48.1	0.0	0.0	38.5	45.0	73.4	205.0
Cotton (4-Pickings)	48.1	0.0	0.0	38.5	45.0	73.4	205.0
Sugarcane	1,041.4	1,216.6	0.0	140.8	22.5	91.2	2,512.4
Traditional Oilseeds*	213.5	10.1	0.0	75.7	22.5	68.4	390.3
Non-Traditional Oilseeds	46.9	10.1	0.0	75.7	22.5	68.4	223.7
Pulses (Mung)**	100.7	0.0	0.0	31.0	22.5	21.3	175.5
Vegetables (Chillies)**	48.2	679.3	0.0	144.7	33.7	118.2	1,024.2
Kharif Fodder	98.1	0.0	0.0	56.0	0.0	49.4	203.6
RABI:							
Wheat	213.0	0.0	0.0	76.7	45.0	27.4	362.2
Late Wheat	213.0	0.0	0.0	76.7	45.0	27.4	362.2
Barley	242.8	0.0	0.0	61.3	0.0	27.4	331.5
Pulses (Gram)**	173.5	27.4	0.0	46.4	0.0	21.3	268.6
High Value Crops (Potato)**	7,281.8	13.9	0.0	568.5	0.0	102.8	7,967.0
Traditional Oilseeds***	33.0	10.1	0.0	39.5	0.0	58.1	140.7
Non-Traditional Oilseeds***	46.9	10.1	0.0	39.5	0.0	58.1	154.6
Rabi Fodder	164.8	10.1	0.0	58.0	0.0	49.4	282.3

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

TABLE AI.17: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS BALUCHISTAN, ZONE 6, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	56.4	13.2	0.0	101.9	19.1	91.2	281.8
Other Rice	28.4	13.2	0.0	111.5	32.6	91.2	276.9
Coarse Grains	135.3	22.3	0.0	29.8	0.0	21.3	208.8
Cotton (3-Pickings)	52.4	0.0	0.0	157.3	45.0	73.4	328.1
Cotton (4-Pickings)	52.4	0.0	0.0	157.3	45.0	73.4	328.1
Sugarcane	1,118.5	1,216.6	0.0	211.6	22.5	91.2	2,660.3
Traditional Oilseeds*	213.5	10.1	0.0	132.3	15.7	68.4	440.1
Non-Traditional Oilseeds	46.9	10.1	0.0	132.3	15.7	68.4	273.5
Pulses (Mung)**	100.7	0.0	0.0	43.3	15.7	21.3	181.1
Vegetables (Chillies)**	48.2	679.3	0.0	171.1	33.7	118.2	1,050.5
Kharif Fodder	98.1	0.0	0.0	100.6	0.0	49.4	248.1
RABI:							
Wheat	213.0	0.0	0.0	73.9	45.0	27.4	359.3
Late Wheat	213.0	0.0	0.0	73.9	45.0	27.4	359.3
Barley	242.8	0.0	0.0	59.1	0.0	27.4	329.4
Pulses (Gram)**	173.5	27.4	0.0	45.2	0.0	21.3	267.3
High Value Crops (Potato)**	7,281.8	9.3	0.0	617.9	0.0	102.8	8,011.7
Traditional Oilseeds***	33.0	10.1	0.0	54.7	0.0	58.1	155.9
Non-Traditional Oilseeds***	46.9	10.1	0.0	54.7	0.0	58.1	169.8
Rabi Fodder	164.8	10.1	0.0	102.5	0.0	49.4	326.8

Source: EAN Farm Income Estimates

TABLE AI.18: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS BALUCHISTAN, ZONE 6, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost						
	Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	47.0	13.2	0.0	109.0	16.8	91.2	277.1
Other Rice	21.3	13.2	0.0	148.0	32.6	91.2	306.2
Coarse Grains	135.3	22.3	0.0	33.9	0.0	21.3	212.9
Cotton (3-Pickings)	62.3	0.0	0.0	254.8	45.0	73.4	435.5
Cotton (4-Pickings)	62.3	0.0	0.0	254.8	45.0	73.4	435.5
Sugarcane	1,118.5	1,216.6	0.0	269.7	22.5	91.2	2,718.4
Traditional Oilseeds*	213.5	10.1	0.0	210.7	11.2	68.4	514.0
Non-Traditional Oilseeds	46.9	10.1	0.0	210.7	11.2	68.4	347.4
Pulses (Mung)**	100.7	0.0	0.0	57.7	11.2	21.3	191.0
Vegetables (Chillies)**	48.2	679.3	0.0	198.6	33.7	118.2	1,078.1
Kharif Fodder	98.1	0.0	0.0	180.2	0.0	49.4	327.7
RABI:							
Wheat	213.0	0.0	0.0	92.3	45.0	27.4	377.7
Late Wheat	213.0	0.0	0.0	92.3	45.0	27.4	377.7
Barley	242.8	0.0	0.0	72.9	0.0	27.4	343.2
Pulses (Gram)**	173.5	27.4	0.0	48.4	0.0	21.3	270.5
High Value Crops (Potato)**	7,281.8	0.0	0.0	664.3	0.0	102.8	8,048.9
Traditional Oilseeds***	33.0	10.1	0.0	68.9	0.0	58.1	170.1
Non-Traditional Oilseeds***	46.9	10.1	0.0	68.9	0.0	58.1	184.0
Rabi Fodder	164.8	10.1	0.0	182.1	0.0	49.4	406.5

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

TABLE AI.19: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-IRRIGATED, ZONE 7, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	74.9	4.1	0.0	127.8	31.3	153.1	396.3
Other Rice	28.2	4.1	0.0	114.0	22.7	158.1	327.1
Coarse Grains	94.5	0.9	0.0	47.8	7.8	59.3	210.3
Cotton (3-Pickings)	168.3	9.1	0.0	100.1	31.3	83.0	391.9
Sugarcane	994.1	6.3	0.0	141.9	15.7	203.6	1,361.6
Traditional Oilseeds*	211.6	1.3	0.0	60.6	15.7	0.0	289.1
Non-Traditional Oilseeds	46.9	1.3	0.0	60.6	15.7	0.0	124.4
Pulses (Mung)**	108.4	0.0	0.0	23.6	15.7	0.0	147.7
Vegetables (Chillies)**	17.7	41.3	0.0	136.4	23.5	0.0	218.9
Kharif Fodder	110.1	0.0	0.0	30.9	0.0	0.0	141.0
RABI:							
Wheat	188.4	0.0	0.0	68.3	39.2	59.3	355.1
Late Wheat	188.4	0.0	0.0	68.3	39.2	59.3	355.1
Barley	188.1	0.0	0.0	32.9	0.0	0.0	221.0
Pulses (Gram)**	163.1	1.5	0.0	30.0	32.9	55.4	282.8
High Value Crops (Potato)**	11,617.7	13.9	0.0	810.1	0.0	102.8	12,544.6
Traditional Oilseeds***	23.4	1.3	0.0	34.2	0.0	58.1	117.0
Non-Traditional Oilseeds***	46.9	1.3	0.0	34.2	0.0	58.1	140.4
Rabi Fodder	93.8	1.3	0.0	19.4	0.0	43.5	157.9

Source: EAN Farm Income Estimates

TABLE AI.20: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-IRRIGATED, ZONE 7, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	64.7	4.1	0.0	128.5	31.3	158.1	386.8
Other Rice	33.8	4.1	0.0	153.8	22.7	158.1	372.6
Coarse Grains	94.5	0.9	0.0	58.2	7.8	59.3	220.7
Cotton (3-Pickings)	168.3	9.1	0.0	116.7	31.3	83.0	408.5
Sugarcane	994.1	6.3	0.0	166.7	15.7	203.6	1,386.4
Traditional Oilseeds*	211.6	1.3	0.0	100.0	11.0	0.0	323.8
Non-Traditional Oilseeds	46.9	1.3	0.0	100.0	11.0	0.0	159.1
Pulses (Mung)**	108.4	0.0	0.0	32.2	11.0	0.0	151.5
Vegetables (Chillies)**	17.7	41.3	0.0	154.5	23.5	0.0	237.0
Kharif Fodder	110.1	0.0	0.0	36.6	0.0	0.0	146.6
RABI:							
Wheat	193.6	0.0	0.0	73.1	39.2	59.3	365.2
Late Wheat	193.6	0.0	0.0	73.1	39.2	59.3	365.2
Barley	188.1	0.0	0.0	38.2	0.0	0.0	226.3
Pulses (Gram)**	163.1	1.5	0.0	37.9	32.9	55.4	290.7
High Value Crops (Potato)**	11,617.7	9.3	0.0	844.1	0.0	102.8	12,573.9
Traditional Oilseeds***	23.4	1.3	0.0	44.6	0.0	58.1	127.4
Non-Traditional Oilseeds***	46.9	1.3	0.0	44.6	0.0	58.1	150.8
Rabi Fodder	93.8	1.3	0.0	24.6	0.0	43.5	163.1

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

TABLE AI.21: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-IRRIGATED, ZONE 7, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	64.7	4.1	32.2	158.5	31.3	158.1	448.9
Other Rice	33.8	4.1	0.0	160.1	22.7	158.1	378.9
Coarse Grains	94.5	0.9	0.0	69.2	7.8	59.3	231.7
Cotton (3-Pickings)	168.3	9.1	0.0	129.0	31.3	83.0	420.8
Sugarcane	994.1	6.3	0.0	192.1	15.7	203.6	1,411.8
Traditional Oilseeds*	211.6	1.3	0.0	154.7	7.8	0.0	375.3
Non-Traditional Oilseeds	46.9	1.3	0.0	154.7	7.8	0.0	210.7
Pulses (Mung)**	108.4	0.0	0.0	42.1	7.8	0.0	158.3
Vegetables (Chillies)**	17.7	41.3	0.0	172.8	23.5	0.0	255.3
Kharif Fodder	110.1	0.0	0.0	42.9	0.0	0.0	153.0
RABI:							
Wheat	209.3	0.0	0.0	103.7	39.2	59.3	411.5
Late Wheat	209.3	0.0	0.0	103.7	39.2	59.3	411.5
Barley	188.1	0.0	0.0	44.3	0.0	0.0	232.4
Pulses (Gram)**	163.1	1.5	0.0	45.4	32.9	55.4	298.3
High Value Crops (Potato)**	11,617.7	0.0	0.0	876.0	0.0	102.8	12,596.5
Traditional Oilseeds***	23.4	1.3	0.0	54.3	0.0	58.1	137.0
Non-Traditional Oilseeds***	46.9	1.3	0.0	54.3	0.0	58.1	160.5
Rabi Fodder	93.8	1.3	0.0	29.1	0.0	43.5	167.6

Source: EAN Farm Income Estimates

TABLE AI.22: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-UNIRRIGATED, ZONE 8, SMALL FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	115.2	4.1	0.0	55.7	24.6	0.0	199.6
Other Rice	33.8	4.1	0.0	67.8	22.7	0.0	128.5
Coarse Grains	127.4	0.9	0.0	29.5	0.0	0.0	157.8
Cotton (3-Pickings)	168.3	9.1	0.0	81.6	31.3	83.0	373.4
Sugarcane	994.1	6.3	0.0	143.2	15.7	0.0	1,159.3
Traditional Oilseeds*	211.8	1.3	0.0	60.6	15.7	0.0	289.3
Non-Traditional Oilseeds	46.9	1.3	0.0	60.6	15.7	0.0	124.4
Pulses (Mung)**	105.0	0.0	0.0	23.4	15.7	0.0	144.1
Vegetables (Chillies)**	17.7	41.3	0.0	136.4	23.5	0.0	218.9
Kharif Fodder	110.1	0.0	0.0	30.9	0.0	0.0	141.0
RABI:							
Wheat	202.5	0.0	0.0	46.6	31.3	0.0	280.5
Late Wheat	202.5	0.0	0.0	46.6	31.3	0.0	280.5
Barley	224.7	0.0	0.0	32.2	0.0	0.0	256.9
Pulses (Gram)**	163.1	1.5	0.0	9.9	23.5	0.0	197.9
High Value Crops (Potato)**	17,143.0	13.9	0.0	1,141.7	39.2	0.0	18,337.7
Traditional Oilseeds***	23.1	1.3	0.0	34.2	23.5	0.0	82.1
Non-Traditional Oilseeds***	46.9	1.3	0.0	34.2	23.5	0.0	105.9
Rabi Fodder	93.8	1.3	0.0	19.4	0.0	0.0	114.4

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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TABLE AI.23: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-UNIRRIGATED, ZONE 8, MEDIUM FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	122.2	4.1	0.0	91.7	13.3	0.0	231.3
Other Rice	45.1	4.1	0.0	54.9	22.7	0.0	126.8
Coarse Grains	127.4	0.9	0.0	32.6	0.0	0.0	160.9
Cotton (3-Pickings)	168.3	9.1	0.0	98.2	31.3	83.0	390.0
Sugarcane	994.1	6.3	0.0	166.7	15.7	0.0	1,182.8
Traditional Oilseeds*	211.8	1.3	0.0	100.0	11.0	0.0	324.1
Non-Traditional Oilseeds	46.9	1.3	0.0	100.0	11.0	0.0	159.2
Pulses (Mung)**	105.0	0.0	0.0	32.0	11.0	0.0	148.0
Vegetables (Chillies)**	17.7	41.3	0.0	154.5	23.5	0.0	237.0
Kharif Fodder	110.1	0.0	0.0	36.6	0.0	0.0	146.6
RABI:							
Wheat	202.5	0.0	0.0	52.5	31.3	0.0	286.3
Late Wheat	202.5	0.0	0.0	52.5	31.3	0.0	286.3
Barley	224.7	0.0	0.0	36.6	0.0	0.0	261.3
Pulses (Gram)**	163.1	1.5	0.0	9.9	23.5	0.0	197.9
High Value Crops (Potato)**	17,143.0	9.3	0.0	1,175.7	39.2	0.0	18,367.1
Traditional Oilseeds***	23.1	1.3	0.0	44.6	23.5	0.0	92.4
Non-Traditional Oilseeds***	46.9	1.3	0.0	44.6	23.5	0.0	116.2
Rabi Fodder	93.8	1.3	0.0	24.6	0.0	0.0	119.6

Source: EAN Farm Income Estimates

TABLE AI.24: PER HECTARE CROP-SPECIFIC COSTS FOR RABI AND KHARIF SEASONS NWFP-UNIRRIGATED, ZONE 8, LARGE FARMS

(Rupees/Hectare)

Crop	Type of Cost: Seed	Pesticides	Thresher	Interest	Artisan	Water Rate	Total
KHARIF:							
Basmati Rice	101.8	4.1	0.0	85.9	11.7	0.0	203.6
Other Rice	33.8	4.1	0.0	111.2	22.7	0.0	171.8
Coarse Grains	127.4	0.9	0.0	35.6	0.0	0.0	163.9
Cotton (3-Pickings)	168.3	9.1	0.0	110.5	31.3	83.0	402.3
Sugarcane	994.1	6.3	0.0	194.1	15.7	0.0	1,210.2
Traditional Oilseeds*	211.8	1.3	0.0	154.7	7.8	0.0	375.6
Non-Traditional Oilseeds	46.9	1.3	0.0	154.7	7.8	0.0	210.7
Pulses (Mung)**	105.0	0.0	0.0	41.9	7.8	0.0	154.8
Vegetables (Chillies)**	17.7	41.3	0.0	172.8	23.5	0.0	255.3
Kharif Fodder	110.1	0.0	0.0	42.9	0.0	0.0	153.0
RABI:							
Wheat	202.5	0.0	0.0	59.8	31.3	0.0	293.7
Late Wheat	202.5	0.0	0.0	59.8	31.3	0.0	293.7
Barley	224.7	0.0	0.0	42.1	0.0	0.0	266.8
Pulses (Gram)**	163.1	1.5	0.0	9.9	23.5	0.0	197.9
High Value Crops (Potato)**	17,143.0	0.0	0.0	1,207.5	39.2	0.0	18,389.7
Traditional Oilseeds***	23.1	1.3	0.0	54.3	23.5	0.0	102.1
Non-Traditional Oilseeds***	46.9	1.3	0.0	54.3	23.5	0.0	125.9
Rabi Fodder	93.8	1.3	0.0	29.1	0.0	0.0	124.1

Source: EAN Farm Income Estimates

FOOTNOTES FOR BOTH TABLES:

*Based on Groundnut Costs
**Costs Based on Representative Product in Parentheses
***Based on Rapeseed and Mustard Costs

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ANNEX II

MODELLING DEMAND AND MARKETING MARGINS IN PASM

As discussed in the main text, demand in PASM is entered as the value of the area under a demand curve at different points on the curve. The method of calculating these values comes from Hazel and Norton and is presented in the first section of this Annex. (There is also a spreadsheet which has been developed called DENCHG.WK1 which makes these calculations. This is available with copies of the model). Following this theoretical discussion are the calculations of the main inputs required for the calculation of demand-- base year prices, quantities and estimates of retail demand elasticities-- which are presented in the second section. The final section of the Annex summarizes the data for imports and exports.

AII.1 Calculating the Area under the Demand Curve for an Agricultural Sector Model

The procedures in DEMCHG.WK1 used to create values for the area under the demand curve are presented in this section. For each product a base price, quantity and retail demand elasticity is needed. These are entered into the first three lines of Table AII.1, which shows the data and formulas used to derive the demand portion of PASM. Given these data inputs, the formulas calculate three different sets of coefficients for the model. First, the area under the demand curve at each point is found and entered as a positive value in the objective function. In the process of maximizing, the model tries to make these values as large as possible because they are positive. It also minimizes costs of production because they are entered as negative values. The quantities demanded at each point on the curve are also derived. They are entered as coefficients in the final demand columns and national demand rows. (This implies that the activities in the final demand columns are not quantities demanded, which is the case. See Section 2.2.3 in the main report for a discussion of the convex combination constraints and what each demand activity implies.) Finally, the gross revenues which are received at each demand point are also calculated for use in the farm income row, FARMINC.

The steps outlined in Hazel and Norton (pp. 176-178) are given in sequence in Table AII.1. In the first three lines the data are input for use in Step 1, with the cell reference for the Lotus spreadsheet given to the right of the equation. The subsequent formulas are based on these cell references. It is well known that given elasticities and one price-quantity point, a linear demand curve can be created. In Step 1, the demand curve is P = a -b*Q, the inverse demand curve, and the "Beta" step calculates b and the "Alpha" step calculates a.

Step 2 then describes the range of the demand segment to be included in the model. The formulas indicate that price ranges are first found by choosing an upper price which is twice the base price and a lower price which is half the base price. Given these prices, the associated quantities are then determined in the last part of Step 2. These give the upper and lower prices and quantities, which determine the first and last points on the demand curve. In Step 3, the entire range of the demand curve specified in Step 2 is segmented into equal sections. This segment length is used to determine the distance between each of the points used to represent the demand curve. Those points are also constructed in Step 3, which gives quantities used as coefficients in the national demand equations. The structure of the national demand equations, including where the quantity values enter those equations, is shown in the main report in Section 2.2.3.

In Step 4 the consumer surplus and revenue values associated with each quantity point are determined. Given linear demand functions, the area and revenue functions are quadratic. The construction of these from linear demand curves are as follows:

The objective function in an agricultural sector model is the net of areas A + B - C, which is the area under the demand curve minus total costs of production, and which corresponds to the sum of producer and consumer surplus. (Review the graphical discussion in

Section 2.1.3 of the main report to see how this is true). The demand functions in PASM thus give the areas A and B. B is simply price times quantity, or the gross revenues at a given price and quantity. Area A is the triangle usually associated with consumer surplus. In mathematical terms these are:

$$\text{Areas } B + A = P*Q + 1/2*(a-P)*Q \qquad \text{Eq. 1}$$

To clear the "P" from the equation 1, the inverse demand function is used:

$$P = a - b*Q \qquad \text{Eq. 2}$$

Giving :

$$\begin{aligned} B + A &= (a-b*Q)*Q + 1/2*(a-(a-bQ))*Q \\ &= aQ - 1/2*bQ^2 \qquad \text{Eq. 3} \end{aligned}$$

In Step 4 in DEMCHG.WK1, equation 3 is evaluated at each quantity point on the demand curve. We chose to divide the curve into ten segments and eleven points, so there are eleven formulas presented. Also, for the purposes of computing farm income, gross revenues are needed. These are simply area B, or the first term of equations 1 and 3 above. This is found in the second eleven formulas.

AII.2 Data Used in Constructing PASM Demand Functions.

The previous section pointed out three initial values needed to develop the demand side of the model: a base quantity, price and an assumed elasticity. The values used for the base run of PASM are discussed in this section. In the first three tables, the supporting work for these values is shown, while the fourth table presents a summary of the data as it appears in the DEMCHG spreadsheet.

Retail Prices. The first table shows the retail prices in 1987/88 and the aggregation of commodities into the larger groups used in the model. Basmati rice and Other Rice are each separate categories, so prices were taken directly from the Economic Survey and Agricultural Statistics. However, other categories, such as milk or sugar, are made up of a number of different sub-commodities so that the prices need to be combined into an average price. For example, the retail price of sugar in the model would be a weighted average of the prices of milled sugar, gur sugar and imported sugar. Likewise, milk products are made up of raw milk, UHT milk, yogurt and imported milk products. Usually, these prices were taken from the Economic Analysis Network's work on marketing margins (Lodhi) or from Agricultural Statistics. A few prices had to be constructed from the Monthly Statistical Bulletin of the Federal Bureau of Statistics.

TABLE AII.1: MAKING DEMAND SEGMENTS FOR THE PASM MODEL

Base Price (BP):		24.67
Base Quantity (BQ):		152.46
Own-Price Elasticity (EE):		-0.8
Step 1 Beta =	-BP/(BQ*EE)	(C8)
Alpha =	+BP+(C8*BQ)	(C9)
Step 2: Upper Price	2*BP	(C12)
Lower Price	0.5*BP	(C13)
Upper Quantity	(C9-C13)/C8	(C14)
Lower Quantity	(C9-C12)/C8	(C15)
Step 3: Segment length:	(C14-C15)/10	(C16)
Q1	+C15	(C18)
Q2	+C20+$C$18	(C19)
Q3	+C21+$C$18	(C20)
Q4	+C22+$C$18	(C21)
Q5	+C23+$C$18	(C22)
Q6	+C24+$C$18	(C23)
Q7	+C25+$C$18	(C24)
Q8	+C26+$C$18	(C25)
Q9	+C27+$C$18	(C26)
Q10	+C28+$C$18	(C27)
Q11	+C29+$C$18	(C28)

Step 4: Area Under the D-Curve:

W1	+$C$9*C20-0.5*$C$8*C20^2
W2	+$C$9*C21-0.5*$C$8*C21^2
W3	+$C$9*C22-0.5*$C$8*C22^2
W4	+$C$9*C23-0.5*$C$8*C23^2
W5	+$C$9*C24-0.5*$C$8*C24^2
W6	+$C$9*C25-0.5*$C$8*C25^2
W7	+$C$9*C26-0.5*$C$8*C26^2
W8	+$C$9*C27-0.5*$C$8*C27^2
W9	+$C$9*C28-0.5*$C$8*C28^2
W10	+$C$9*C29-0.5*$C$8*C29^2
W11	+$C$9*C30-0.5*$C$8*C30^2
R1	($C$9*C20-$C$8*C20^2)
R2	($C$9*C21-$C$8*C21^2)
R3	($C$9*C22-$C$8*C22^2)
R4	($C$9*C23-$C$8*C23^2)
R5	($C$9*C24-$C$8*C24^2)
R6	($C$9*C25-$C$8*C25^2)
R7	($C$9*C26-$C$8*C26^2)
R8	($C$9*C27-$C$8*C27^2)
R9	($C$9*C28-$C$8*C28^2)
R10	($C$9*C29-$C$8*C29^2)
R11	($C$9*C30-$C$8*C30^2)

Retail Quantities. The quantities consumed at retail are essentially derived from calculating the disappearance of farm production, taking into account imports, exports, changes in stocks and losses in the marketing system. Table AII.2 displays the data and calculations for retail quantities consumed during 1987/88. The total production of each sub-commodity is the starting point. Imports are added to the total and exports are subtracted because the calculation is for domestic demand. Since exports are net of marketing losses, it is assumed that a higher figure must be taken from total production than the export figure given in Agricultural Statistics. This is the rationale for making the adjustments shown in the fifth column. Changes in stocks are only reported for major crops, but are significant for both wheat and cotton. For other crops, it is assumed that all production is used within one year. These adjustments taken together give the net farm quantity demanded for the model. From this point, two other adjustments need to be made: first the volume which goes into direct feeding of livestock needs to be deducted from production; and then the remaining amount must be converted to retail quantities by adjusting for losses in the distribution system. The factors used to make these adjustments are given in the second- and third-to-last columns of Table AII.2. The final columns then give net retail quantities demanded for each commodity.

TABLE AII.1: RETAIL, IMPORT AND EXPORT PRICES USED AS DATA INPUTS FOR PASM DEMAND FUNCTIONS

Product	Group Ref.	1987/88 Retail Price (Rs/Kg)	Retail Weights ('000 MT)	Import/Exp. Price (Rs/MT)
Basmati Rice	RIB	8.25	1.00	12855
Other Rice	RIO	3.81	1.00	3619
Mill Sugar	SUG	9.77	0.63	
Mill Sugar, Imported	SUG	9.77	0.06	
Gur Sugar	SUG	5.74	0.31	
Sugar-Av.	SUG	8.53	1.00	3813
Gram	PUL	6.30	0.74	
Mash	PUL	12.05	0.04	
Mung	PUL	11.75	0.05	
Masoor	PUL	10.73	0.04	
Imported Pulses	PUL	11.11	0.11	
Pulses - Av.	PUL	7.60	1.00	5168
Wheat Flour	WHE	2.58	0.96	
Imptd. Wheat	Whe	2.58	0.04	
Bread	WHE	6.26	0.00	
Wheat Products -Av	WHE	2.59	1.00	3220
Beef	BEE	16.91	1.00	
Mutton	MUT	36.71	1.00	
Poultry	POU	24.67	1.00	
Eggs	EGG	0.92	1.00	
Milk	MIL	6.08	0.96	
UHT	MIL	7.62	0.01	
Yogurt	MIL	7.35	0.00	
Imported Milk Produc	MIL	2.15	0.03	
Milk Products	MIL	5.98	1.00	1079
Butter	BUT	47.98	1.00	
Animal Ghee	AGE	49.40	1.00	
Chillies	VEG	15.10	0.01	
Onions	VEG	4.15	0.17	
Potatoes	VEG	5.15	0.17	
Tomatoes	VEG	7.36	0.05	
Others	VEG	5.28	0.47	
Sugarbeets	VEG	5.28	0.13	
All Vegetables	VEG	5.28	1.00	
Citrus	FRU	0.62	0.40	
Mango	FRU	14.78	0.20	
Banana	FRU	0.63	0.06	
Apple	FRU	16.68	0.06	
Guava	FRU	12.00	0.10	
Dates	FRU	14.68	0.07	
Other	FRU	7.27	0.11	
All Fruits	FRU	7.26	1.00	5299

TABLE AII.1, cont.: RETAIL, IMPORT AND EXPORT PRICES USED AS DATA INPUTS FOR PASM DEMAND FUNCTIONS

Product	Group Ref.	1987/88 Retail Price (Rs/Kg)	Retail Weights ('000 MT)	Import/Exp. Price (Rs/MT)
Mustard Oil	VGE	16.39	0.02	
Vegetable Ghee	VGE	16.51	0.04	
Imported Veg Ghee	VGE	16.51	0.94	
Edible Oils - Av.	VGE	16.51	1.00	7677
Coarse Grains	COG			
Maize	COG	3.09	0.61	
Bajra	COG	4.52	0.09	
Jowar	COG	3.20	0.12	
Guarseed	COG	3.20	0.10	
Barley	COG	2.66	0.07	
		3.21	1.00	
Cotton	COT	147.33	1.00	34786
Liquid Oil	LOI	17.00	1.00	

Sources: EAN Marketing Margin Estimates, Agricultural Statistics, 1988/89; Monthly Bulletin of Statistics, Various Issues.

TABLE AII.2: DERIVATION OF RETAIL QUANTITIES USED IN THE PASM MODEL BASE SOLUTION

Product	Group Ref.	Total Production	Marketed Surplus	Imports	Exports	Exports Farm Q	Change in Stocks	Farm Quantity Demanded	Conversion Factor	Direct Feeding Percentage	Net Quantity Demanded
		('000 MT)	('000 MT)	('000 MT)	('000 MT)	('000 MT)	('000 MT)	('000 MT)			('000 MT)
Basmati Rice	RIB	943	707		-220	-222		721	0.990	0.02	699
Other Rice	RIO	2298	1724		-614	-620		1678	0.990	0.02	1627
Mill Sugar	SUG	1782	1782					1782	0.980	0.01	1729
Mill Sugar, Imported	SUG			179				179	0.950	0.01	168
Gur Sugar	SUG	899	899					899	0.950	0.01	845
Sugar-Av.	SUG	2681	2681	179				2860	0.970	0.01	2742
Gram	PUL	583	583					583	0.840	0.12	420
Mash	PUL	35	35					35	0.770	0.05	25
Mung	PUL	43	43					43	0.770	0.05	31
Masoor	PUL	33	33					33	0.790	0.05	24
Imported Pulses	PUL			66				66	0.98		65
Pulses - Av.	PUL	694	694					760	0.830		565
Wheat Flour	WHE	11973	5067				745	12718	0.820	0.05	9830
				482				482	0.820		395
Bread	WHE	43		0				43	0.840		36
Wheat Products -Av	WHE	12016	17126	482			745	13243	0.820		10261
Beef	BEE	595	595					595	1.000		595
Mutton	MUT	570	570					570	1.000		570
Poultry	POU	154	154					154	0.990		152
Eggs	EGG	4E+06	4140000					4140000	0.980		4057200
Milk	MIL	10482	5894					10482	1.220		12788
UHT	MIL	85	85					85	1.370		116
Yogurt	MIL	50	50					50	0.760		38
Imported Milk Product	MIL	0	0	380				380	1.000		380
Milk Products	MIL	10617	6029	380	0			10997	1.219		13406
Butter	BUT	65	65	0				65	1.000		65
Animal Ghee	AGE	118	118	0				118	1.000		118
Chillies	VEG	84	84		-14	-24		60	0.580	0.05	32
Onions	VEG	633	633		-63	-68		565	0.920	0.05	491
Potatoes	VEG	563	563					563	0.930	0.05	495
Tomatoes	VEG	162	162					162	0.950	0.05	146
Others	VEG	1639	1639		-9	-10		1629	0.910	0.05	1401
Sugarbeet	VEG	456	456					456	0.910	0.05	392
All Vegetables	VEG	3537	3537		-86	-95		3442	0.909	0.05	2957

TABLE AII.2, cont.: DERIVATION OF RETAIL QUANTITIES USED IN THE PASM MODEL BASE SOLUTION

Product	Group Ref.	Total Production ('000 MT)	Marketed Surplus ('000 MT)	Imports ('000 MT)	Exports ('000 MT)	Exports Farm Q ('000 MT)	Change in Stocks ('000 MT)	Farm Quantity Demanded ('000 MT)	Conversion Factor	Direct Feeding Percentage	Net Quantity Demanded ('000 MT)
Citrus	FRU	1411	1411		-20	-23		1388	0.870		1208
Mango	FRU	713	713		-11	-13		700	0.870		609
Banana	FRU	206	206					206	0.850		175
Apple	FRU	212	212					212	0.850		180
Guava	FRU	335	335					335	0.870		291
Dates	FRU	277	277		-36	-41		236	0.870		205
Other	FRU	432	432		-37	-43		389	0.870		339
All Fruits	FRU	3586	3586		-104	-120		3466	0.868		3007
Mustard Oil	VGE	61	61					61	0.330		20
Vegetable Ghee	VGE	286	286					286	0.120		34
Imported Veg Ghee	VGE			877				877	0.970		851
Edible Oils - Av.	VGE										0
Coarse Grains	COG										
Maize	COG	1127	1127					1127	0.810	0.26	620
Bajra	COG	135	135					135	0.810	0.12	93
Jowar	COG	181	181					181	0.810	0.12	125
Guarseed	COG	150	150					150	0.810	0.12	104
Barley	COG	112	112					112	0.800	0.12	76
Coarse Grains - Tot	COG	1705	1705					1705	0.809		1017
Cotton	COT	1472	1472		-962	-1034	-175	263	0.845		222
Liquid Oil	LOI	48	48	13				61	0.930 0.970		59

Sources: Agricultural Statistics, 1988/89; EAN Marketing Margin Estimates; PASM Model, Annex IV, Table AIV.9

Demand Elasticities. The final data inputs required for the demand side of PASM are the price elasticities of demand. Estimates from several different sources are shown in Table AII.3. The first two estimates -- Etisham, Ludlow and Stern, and Alderman -- come from simultaneous equations models reported in the Pakistan Development Review. The Etisham, Ludlow, and Stern values are based on a linear expenditure system while the Alderman estimations are income-compensated elasticities from an AIDS estimation. The third and fourth values are from the PAKSIM model, which was developed by Davies under EAN sponsorship and was used in earlier work in the RONCO project. Because the PAKSIM model was based on an earlier model done by IFPRI, the values are similar for both. The final column of values came from selected works from the EAN Project and were incorporated where they were known.

The final columns show a simple average of the different values. This was used as a starting point for the demand curves in the model. It is of course not a particularly sophisticated decision process, but the spirit in which demand was approached was consistent with using these as a starting point. The general process of debugging the model was to get the supply sides to work in each region first and then to combine them and adjust demand by changing the elasticities until the model made sense. Given the wide range of results shown in Table AII.3, it was deemed better to let the model tell us what elasticities were consistent with a "validated" model rather than to maintain a preconceived notion of what is right. Thus the simple average was as good a starting point as any other.

A Summary of Data Inputs used in the Base Run of PASM. In Table AII.4 below, a summary of the basic demand values are given. The prices and quantities are simply restated from earlier tables, with changes in units to reflect the units in the model. Prices in PASM's objective function are in Crore (Rs 10,000,000) and quantities are in metric tons (except for eggs, which are Millions of eggs). These may be changed at a later date when the model is scaled to make all coefficients cover a smaller range. The largest coefficients in the model are the demand quantities and are therefore likely candidates for scaling.

The elasticities used in the base solution were somewhat changed from the simple averages reported above. In general meat and milk elasticities were left at the same levels because supply side factors associated with forcing livestock herds to certain levels dominated the response in those commodities. Mutton and poultry were given somewhat larger elasticities than the initial ones because they were assumed to be preferred to beef, with the implication that decreased prices would elicit a greater response. The model has a tendency to choose a more efficient set of technologies to produce each product than actually is done. Therefore, given correct acreage, production is higher and prices are lower than the actual results. Thus the elasticities were generally reduced, especially for kharif crops. (This is probably the wrong strategy. Becasue quantities did not deviate from actuals as much as anticiapted, larger elasticites might be preferred to keep the retial prices closer to actual values). Also, fruits and vegetables were produced quite efficiently in the model, so that a large quantity came into the makret to satisfy current demand. Given that, the elasticities used were probably low and resutled lower prices than necessary. However, without an initial elasticity to get independent estimates for these products, it is hard to know.

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TABLE AII.3: ELASTICITY ESTIMATES FOR PASM DEMAND FUNCTIONS, BASE SOLUTION, 1987/88

Product	Group Ref.	Etisham\ Stern	...Alderman... Rural	Urban	PAKSIM	IFPRI	EAN	Simple Average
Basmati Rice	RIB	-0.599	-1.91	-0.93	-0.21	-0.7		-0.87
Other Rice	RIO					-0.4		-0.40
Mill Sugar	SUG							
Imptd. Mill Sugar	SUG							
Gur Sugar	SUG							
Sugar-Av.	SUG	-0.47			-0.45	-0.45	-0.4	-0.46
Gram	PUL							
Mash	PUL							
Mung	PUL							
Masoor	PUL							
Pulses - Av.	PUL	-0.299	-0.52	-0.33	-0.3	-0.3		-0.35
Wheat Flour	WHE							
Bread	WHE							
Wheat Products -Av	WHE	-0.236	-0.91	-0.31	-0.25	-0.25		-0.25
Beef	BEE	-1.15	-0.29	-1.01	-0.8	-0.8		-0.81
Mutton	MUT		"	"	"	"		0.00
Poultry	POU		"	"	"	"		0.00
Eggs	EGG				-0.58		-0.58	-0.58
Milk	MIL							
UHT	MIL							
Yogurt	MIL							
Imported Milk	MIL							
Milk Products	MIL	-0.69	-1.06	-0.76	-0.58	-0.58	-1.43	-0.73
Butter	BUT							
Animal Ghee	AGE							
Chillies	VEG							
Onions	VEG							
Potatoes	VEG							
Tomatoes	VEG							
Others	VEG							
All Vegetables	VEG							
Citrus	FRU							
Mango	FRU							
Banana	FRU							
Apple	FRU							
Guava	FRU							
Dates	FRU							
Other	FRU							
All Fruits	FRU	"				"		0.00
Mustard Oil	VGE	-0.69		-0.08	-0.57	-0.57		-0.48
Vegetable Ghee	VGE							
Imported Veg Ghee	VGE							
Edible Oils - Av.	VGE							

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TABLE AII.3, cont.: ELASTICITY ESTIMATES FOR PASM DEMAND FUNCTIONS, BASE SOLUTION, 1987/88

Product	Group Ref.	Etisham\ Stern	...Alderman... Rural	Urban	PAKSIM	IFPRI	EAN	Simple Average
Coarse Grains	COG				-0.35	-0.35/-0.38		-0.36
Maize	COG							
Bajra	COG							
Jowar	COG							
Guarseed	COG							
Barley	COG							
Cotton	COT	-0.707			-0.59	-0.59		-0.63
Liquid Oil	LOI							
Other Food		-0.58	-1.04	-1.02				-0.88
Non-Food		-1.11	-1.07	-0.89				-1.02

Ahmad, Ehtisham, Ludlow, Stephen, and Stern, Nicholas. 1988. "Demand Response in Pakistan: A Modification of the Linear Expenditure System for 1976". Pakistan Development Review. (Vol XXVII, No. 3, Autumn)

RONCO PAKSIM Model

TABLE AII.4: A SUMMARY OF DATA INPUTS USED IN THE BASE RUN OF PASM.

	1987/88 Retail Price (Crore Rs./MT)	Total Quantity (MT)	Base Run Elas. val
Basmati Rice	0.000825000	699154	-0.40
Basmati Export	0.001285500	220000	-0.50
Other Rice	0.000381000	1627464	-0.30
Sugar-Av.	0.000852793	2741860	-0.25
Pulses - Av.	0.000759716	565020	-0.35
Wheat Products -Av	0.000259295	10261470	-0.30
Beef	0.001691000	595000	-0.81
Mutton	0.003671000	570000	-0.90
Poultry	0.002467000	152460	-1.00
Eggs	0.000092000	4057200	-0.58
Milk Products	0.000598499	13405723	-0.73
Butter	0.004798000	65000	-0.57
Animal Ghee	0.004940000	118000	-0.57
Vegetables	0.000528000	2956901	-0.25
Fruits	0.000726167	3007460	-0.25
Edible Oils	0.001651000	1187280	-0.57
Cotton	0.014733000	283000	-1.00
Liquid Oil	0.001700000	59170	-0.57
Coarse Grains	0.000321282	1034000	-0.40

Source: Tables AII.1 - 3; DEMCHG.WK1 worksheet

These starting data points and elasticities can be put into the DEMCHG.WK1 spreadsheet to calculate the coefficients needed for objective function values, quantities for the final demand equations, and gross revenues for the farm income row. The results for the data given in Table AII.4 are shown on the following pages, in Tables AII.5-24. In the first column the point on the demand curve is described. With eleven points associated with the demand for each commodity, there are eleven values for each of the three variables. The second column exhibits the computations for the area under the demand curve that go into the objective function. The third column gives the quantities associated with each point, which are the coefficients in the national demand equations. The final column has the gross revenues received from sales to final demand for each of the points on the demand curve. These go into the farm income row.

Table AII.5: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Basmati Rice

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	952	419,493	0.692
2	1,018	461,442	0.704
3	1,080	503,391	0.706
4	1,136	545,340	0.697
5	1,187	587,290	0.678
6	1,233	629,239	0.649
7	1,274	671,188	0.609
8	1,309	713,138	0.559
9	1,339	755,087	0.498
10	1,364	797,036	0.427
11	1,384	838,985	0.346

Table AII.6: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Basmati Rice Export

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	354	110,000	0.283
2	394	126,500	0.301
3	432	143,000	0.313
4	466	159,500	0.318
5	498	176,000	0.317
6	526	192,500	0.309
7	551	209,000	0.296
8	573	225,500	0.275
9	591	242,000	0.249
10	606	258,500	0.216
11	619	275,000	0.177

Table AII.7: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Other Rice

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	1,374	1,139,225	0.868
2	1,428	1,212,461	0.855
3	1,478	1,285,697	0.833
4	1,523	1,358,932	0.803
5	1,564	1,432,168	0.764
6	1,601	1,505,404	0.717
7	1,634	1,578,640	0.662
8	1,663	1,651,876	0.598
9	1,687	1,725,112	0.526
10	1,707	1,798,348	0.445
11	1,723	1,871,584	0.357

Table AII.8: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Sugar

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	6,138	2,056,395	3.507
2	6,307	2,159,215	3.407
3	6,462	2,262,035	3.279
4	6,605	2,364,854	3.126
5	6,734	2,467,674	2.946
6	6,850	2,570,494	2.740
7	6,953	2,673,314	2.508
8	7,043	2,776,133	2.249
9	7,120	2,878,953	1.964
10	7,184	2,981,773	1.653
11	7,234	3,084,593	1.315

Table AII.9: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Pulses

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	818	367,376	0.558
2	861	397,023	0.558
3	901	426,669	0.551
4	938	456,316	0.537
5	971	485,962	0.517
6	1,001	515,609	0.490
7	1,027	545,256	0.456
8	1,050	574,902	0.415
9	1,070	604,549	0.367
10	1,086	634,195	0.313
11	1,099	663,842	0.252

Table AII.10: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Wheat Products

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	5,898	7,183,029	3.725
2	6,128	7,644,795	3.667
3	6,341	8,106,561	3.573
4	6,536	8,568,327	3.444
5	6,712	9,030,094	3.278
6	6,871	9,491,860	3.076
7	7,012	9,953,626	2.839
8	7,134	10,415,392	2.566
9	7,239	10,877,158	2.256
10	7,326	11,338,923	1.911
11	7,395	11,800,691	1.530

Table AII.12: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Beef

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	405	113,050	0.382
2	640	185,342	0.580
3	857	257,635	0.741
4	1,056	329,928	0.865
5	1,236	402,220	0.952
6	1, 98	474,513	1.003
7	1,542	546,805	1.017
8	1,667	619,098	0.995
9	1,774	691,390	0.935
10	1,863	763,683	0.839
11	1,933	835,975	0.707

Table AII.13: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Mutton

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	430	57,000	0.418
2	974	133,950	0.910
3	1,475	210,900	1.316
4	1,934	287,850	1.638
5	2,351	364,800	1.875
6	2,725	441,750	2.027
7	3,057	518,700	2.095
8	3,347	595,650	2.077
9	3,594	672,600	1.975
10	3,799	749,550	1.789
11	3,961	826,500	1.517

Table AII.14: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Poultry

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	0	0	0.000
2	109	22,869	0.104
3	209	45,738	0.192
4	300	68,607	0.262
5	384	91,476	0.316
6	458	114,345	0.353
7	525	137,214	0.372
8	583	160,083	0.375
9	632	182,952	0.361
10	673	205,821	0.330
11	705	228,690	0.282

Table AII.15: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Eggs

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	370	1,704,024	0.314
2	433	2,057,000	0.350
3	490	2,409,977	0.377
4	543	2,762,953	0.394
5	591	3,115,930	0.401
6	634	3,468,906	0.399
7	672	3,821,882	0.387
8	706	4,174,859	0.365
9	734	4,527,835	0.333
10	758	4,880,812	0.292
11	776	5,233,788	0.241

Table AII.16: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Milk Products

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	4,655	3,565,922	4.268
2	6,356	5,041,892	5.582
3	7,924	6,517,863	6.632
4	9,359	7,993,833	7.416
5	10,662	9,469,803	7.935
6	11,832	10,945,773	8.189
7	12,870	12,421,743	8.178
8	13,776	13,897,713	7.902
9	14,549	15,373,683	7.361
10	15,189	16,849,653	6.555
11	15,697	18,325,624	5.484

Table AII.17: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Butter

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	319	27,950	0.268
2	370	33,508	0.297
3	417	39,065	0.319
4	461	44,623	0.332
5	500	50,180	0.337
6	535	55,738	0.334
7	567	61,295	0.324
8	594	66,853	0.305
9	617	72,410	0.278
10	637	77,968	0.243
11	652	83,525	0.200

Table AII.18: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Animal Ghee

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	596	50,740	0.501
2	692	60,829	0.556
3	780	70,918	0.596
4	861	81,007	0.620
5	935	91,096	0.630
6	1,001	101,185	0.625
7	1,059	111,274	0.605
8	1,110	121,363	0.570
9	1,154	131,452	0.519
10	1,190	141,541	0.454
11	1,219	151,630	0.375

Table AII.19: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Vegetables

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	4,098	2,217,675	2.342
2	4,211	2,328,559	2.275
3	4,315	2,439,443	2.190
4	4,410	2,550,327	2.087
5	4,496	2,661,211	1.967
6	4,574	2,772,094	1.830
7	4,643	2,882,978	1.674
8	4,703	2,993,862	1.502
9	4,754	3,104,746	1.311
10	4,796	3,215,629	1.104
11	4,830	3,326,513	0.878

Table AII.20: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Fruits

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	5,733	2,255,595	3.276
2	5,890	2,368,375	3.182
3	6,036	2,481,155	3.063
4	6,169	2,593,934	2.920
5	6,290	2,706,714	2.752
6	6,398	2,819,494	2.559
7	6,494	2,932,274	2.342
8	6,578	3,045,053	2.101
9	6,650	3,157,833	1.834
10	6,709	3,270,613	1.544
11	6,756	3,383,393	1.228

Table AII.21: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Edible Oils

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	2,004	510,530	1.686
2	2,326	612,043	1.869
3	2,624	713,555	2.003
4	2,896	815,068	2.086
5	3,143	916,580	2.119
6	3,365	1,018,093	2.101
7	3,562	1,119,605	2.033
8	3,734	1,221,117	1.915
9	3,881	1,322,630	1.747
10	4,002	1,424,142	1.528
11	4,099	1,525,655	1.259

Table AII.22: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Cotton

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	0	0	0.000
2	1,204	42,450	1.157
3	2,314	84,900	2.126
4	3,330	127,350	2.908
5	4,253	169,800	3.502
6	5,082	212,250	3.909
7	5,816	254,700	4.128
8	6,457	297,150	4.159
9	7,005	339,600	4.003
10	7,458	382,050	3.659
11	7,818	424,500	3.127

Table AII.23: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Liquid Oil

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	103	25,443	0.087
2	119	30,502	0.096
3	135	35,561	0.103
4	149	40,620	0.107
5	161	45,679	0.109
6	173	50,738	0.108
7	183	55,797	0.104
8	192	60,856	0.098
9	199	65,915	0.090
10	205	70,974	0.078
11	210	76,033	0.065

Table AII.24: Total Consumer Surplus, Quantities Demanded and Gross Revenues for

Coarse Grains

Point on Dem. Curve	Area under Dem. Curve	Quantity Demanded	Gross Revenue
--	Crore Rs.	Metric ton	Billions Rs.
1	548	620,400	0.399
2	587	682,440	0.406
3	622	744,480	0.407
4	654	806,520	0.402
5	684	868,560	0.391
6	710	930,600	0.374
7	734	992,640	0.351
8	754	1,054,680	0.322
9	771	1,116,720	0.287
10	786	1,178,760	0.246
11	797	1,240,800	0.199

Marketing Margins and Conversion Factors for Losses in Marketing. The marketing function, while adding value to products, incurs costs and losses in quantities as farm production moves from the farmgate to the final consumer. This section describes the sources of data and resulting estimates used to model these functions. The costs of marketing each product are marketing margins in the objective function while the quantity losses in converting to final demand are coefficients in the marketing columns and final demand rows. The marketing margins for domestic activities are included in this section. There are also similar activities for import and export activities, which are discussed in the following section.

The starting point was the work done for the EAN Marketing Margins estimates, referred to in the following activities as Lodhi after the primary author. Estimates of the per unit marketing margins were published in the EAN studies, as were estimates of losses from domestic production to final demand and from imports to final demand. The domestic marketing margins reported in Lodhi are given in the first column of data in Table AII.25. The EAN food groups did not correspond exactly to the aggregation used in PASM, so different aggregations of the marketing margins had to be developed. This was done by weighting Lodhi's figures by the production weights in the second column and adding each commodity together. The net values adjsuted for PASM use are included in the third column. Finally, Lodhi's figures were based on retail quantities, but in PASM, the cost is for each unit of farm level quantity.

Therefore, costs based on retail units were too high and needed to be reduced by losses in production. Thus the values in the first column in Table AII.25 are multiplied by the production losses in the third column. The final column shows the margins adjusted to farm level units for each product. These values are changed to Crore Rupees before being put into the objective function.

The second table, Table AII.26, shows the derivation of aggregate losses from farmgate to retail. Most coefficients are taken form the marketing margins estimates done by EAN and are attributed to Lodhi. In several other cases, they came from farm income estimates of Mubarik Ali, also done at EAN, or were estimated ad hoc. Finally, the cotton losses were taken from a study by Davies for the textile subsector in Egypt. The relative proportions of yarn, cloth, and clothing produced and exported were taken from the Pakistan Economic Survey, 1989. These figures were adjusted back to farm level quantities by using loss coefficients from Davies' study reach the figure reported in Table x.

Several comments are warranted about the nature of the products implied by these figures. First, rice yields in each of the regions is based on clean rice and not paddy. Thus the losses are quite small. Sugar is only reported as the losses after processing. The actual loss figures used in the model are the reported recovery rates from sugarcane which are reported in Agricultural Statistics, which takes the product to sugar. Additionally, the losses in distribution which are reported in this table are deducted to give total losses from cane to the final product delivered into the hands of the consumer. The wheat losses are after threshing, so farm level yields in PASM reflect cleaned wheat with straw and some bran already having been deducted. Imported milk products were converted to whole milk equivalents so that those heterogenous products would be consistent with domestic milk products. As a result, imports of milk were higher priced than domestic milk and had to be forced into the model. Most imported milk products are purchased because they are higher quality, differentiated products. The losses for coarse grains are assumed because they are not included in the EAN marketing margin estimates at all.

TABLE AII.25: DERIVATION OF DOMESTIC MARKETING MARGINS USED IN PASM

Product	Group Ref.	Domestic Market. Mar. (Lodhi) (Rs/Kg.)	Production Weights	Production Conversion Factors	Farm-Level Marketing Margin (Rs/Kg.)
Basmati Rice	RIB	0.91	1.00		0.91
Other Rice	RIO	0.42	1.00		0.42
Mill Sugar	SUG	6.32	0.66		
Gur Sugar	SUG	2.12	0.34		
Sugar-Av.	SUG	4.91	1.00	0.970	4.76
Gram	PUL	2.47	0.84		
Mash	PUL	5.22	0.05		
Mung	PUL	4.91	0.06		
Masoor	PUL	3.53	0.05		
Imported Pulses	PUL		0		
Pulses - Av.	PUL	2.81	1.00	0.830	2.33
Wheat Flour	WHE	0.66	1.00		
Imptd. Wheat	Whe				
Bread	WHE	1.59	0.00		
Wheat Products -Av	WHE	0.66	1.00	0.820	0.54
Beef	BEE	4.30	1.00	0.450	1.94
Mutton	MUT	15.48	1.00	0.450	6.97
Poultry	POU	5.70	1.00	0.990	5.64
Eggs	EGG	0.19	1.00	0.980	0.19
Milk	MIL	3.27	0.99		
UHT	MIL	5.36	0.01		
Yogurt	MIL	2.66	0.00		
Milk Products	MIL	3.28	1.00	1.219	4.00
Butter	BUT	21.40	1.00	1.000	21.40
Animal Ghee	AGE	10.71	1.00	0.053	0.57
Chillies	VEG	11.33	0.02		
Onions	VEG	1.80	0.18		
Potatoes	VEG	2.06	0.16		
Tomatoes	VEG	5.49	0.05		
Others	VEG	2.64	0.46		
Sugarbeets	VEG	2.64	0.13		
All Vegetables	VEG	2.73	1.00	0.909	2.49
Citrus	FRU	0.49	0.39		
Mango	FRU	11.18	0.20		
Banana	FRU	0.45	0.06		
Apple	FRU	11.95	0.06		
Guava	FRU	3.36	0.09		
Dates	FRU	4.11	0.08		
Other	FRU	4.29	0.12		
All Fruits	FRU	4.30	1.00	0.868	3.73

TABLE AII.25, cont.: DERIVATION OF DOMESTIC MARKETING MARGINS USED IN PASM

Product	Group Ref.	Domestic Market. Mar. (Lodhi)	Production Weights	Production Conversion Factors	Farm-Level Marketing Margin
		(Rs/Kg.)			(Rs/Kg.)
Mustard Oil	VGE	7.08	0.18	0.330	
Vegetable Ghee	VGE	9.53	0.82	0.120	
Imported Veg Ghee	VGE			0.970	
Edible Oils - Av.	VGE	9. 0	1.00		
Coarse Grains	COG				
Maize	COG	0.30	0.66		
Bajra	COG	0.73	0.08		
Jowar	COG	0.34	0.11		
Guarseed	COG	0.34	0.09		
Barley	COG	0.31	0.07		
		0.34	1.00	0.809	0.28
Cotton	COT		1.00	0.845	0.00
Liquid Oil	LOI	8.50	1.00	0.970	8.25

Sources: Agricultural Statistics, 1988/89; EAN Marketing Margin Estimates; PASM Model, Annex II, Table AII.26

TABLE AII.26: COEFFICIENTS FOR QUANTITY LOSSES IN MARKETING USED IN PASM MODEL

Product	Group Ref.	Production Weights	Conversion Factor	Comments
Basmati Rice	RIB	1.00	0.990	1% Loss after Milling (Lodhi)
Other Rice	RIO	1.00	0.990	1% Loss after Milling (Lodhi)
Mill Sugar	SUG	0.66	0.980	From Sugar, Not Cane. Handling Lo
Mill Sugar, Imported	SUG		0.950	From Sugar, Not Cane. Handling Lo
Gur Sugar	SUG	0.34	0.950	From Sugar, Not Cane. Handling Lo
Sugar-Av.	SUG	1.00	0.970	Derived
Gram	PUL	0.84	0.840	Lodhi
Mash	PUL	0.05	0.770	Lodhi
Mung	PUL	0.06	0.770	Lodhi
Masoor	PUL	0.05	0.790	Lodhi
Imported Pulses	PUL	0	0.98	Lodhi
Pulses - Av.	PUL	1.00	0.830	Derived
Wheat Flour	WHE	1.00	0.820	From Threshed Wheat, Ali
Imptd. Wheat	WHE		0.8[illegible]	From Threshed Wheat, Ali
Bread	WHE	0.00	0.840	Lodhi
Wheat Products -Av	WHE	1.00	0.820	Derived
Beef	BEE	1.00	1.000	Lodhi
Mutton	MUT	1.00	1.000	Lodhi
Poultry	POU	1.00	0.990	Lodhi
Eggs	EGG	1.00	0.980	Lodhi
Milk	MIL	0.99	1.220	Lodhi
UHT	MIL	0.01	1.370	Lodhi
Yogurt	MIL	0.00	0.760	Lodhi
Imported Milk	MIL		1.000	Liquid Milk Equivalents; Estimate
Milk Products	MIL	1.00	1.21[illegible]	Derived
Butter	BUT	1.00	1.000	Lodhi; Joint Product with Milk
Animal Ghee	AGE	1.00	0.053	Lodhi

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TABLE AII.26, cont.: COEFFICIENTS FOR QUANTITY LOSSES IN MARKETING USED IN PASM MODEL

Product	Group Ref.	Production Weights	Conversion Factor	Comments
Chillies	VEG	0.02	0.580	Estimated from Ali
Onions	VEG	0.18	0.920	Lodhi
Potatoes	VEG	0.16	0.930	Lodhi
Tomatoes	VEG	0.05	0.950	Lodhi
Others	VEG	0.46	0.910	Average of First 4 Products
Sugarbeet	VEG	0.13	0.910	Average of First 4 Products
All Vegetables	VEG	1.00	0.909	Derived
Citrus	FRU	0.39	0.870	Lodhi
Mango	FRU	0.20	0.870	Lodhi
Banana	FRU	0.06	0.850	Lodhi
Apple	FRU	0.06	0.850	Lodhi
Guava	FRU	0.09	0.870	Average of First 4 Products
Dates	FRU	0.08	0.870	Average of First 4 Products
Other	FRU	0.12	0.870	Average of First 4 Products
All Fruits	FRU	1.00	0.868	Derived
Mustard Oil	VGE	0.18	0.330	Lodhi
Cottonseed Oil	VGE	0.82	0.120	Lodhi
Imported Veg Ghee	VGE		0.970	Lodhi, Processing Losses, Oil to
Edible Oils - Av.	VGE	1.00		Each type of oil has separte conv
Coarse Grains	COG			
Maize	COG	0.66	0.810	14% Bran; 5% Marketing Losses
Bajra	COG	0.08	0.810	14% Bran; 5% Marketing Losses
Jowar	COG	0.11	0.810	14% Bran; 5% Marketing Losses
Guarseed	COG	0.09	0.810	14% Bran; 5% Marketing Losses
Barley	COG	0.07	0.800	15% Bran; 5% Marketing Losses
Coarse Grains - Tot	COG	1.00	0.809	Derived
Cotton	COT	1.00	0.845	Adapted from Davies (1988)
Liquid Oil	LOI	1.00	0.970	Estimated Processing Losses

Expert and Import Quantities, Prices, and Marketing Margins. The quantity exported and imported into the model were used to calculate the net retail quantities demanded, and were shown in Table AII.2. Prices for imports and exports were also reported previously, in Table AII.1. These generally were exclusive of tariffs and subsidies, which are entered into PASM in the international marketing margins which translate international prices into domestic prices. To show how this works, Table AII.27 presents international prices, marketing margins from imports and to exports, and domestic prices (for exports). Most of these are reported in Lodhi as well, but because of the sensitivity of the model to international prices and the prevalence of policies which keep prices from border levels, a careful comparison is useful.

In the first block of Table AII.27, the situation for imports is described. All products which are imported are given in the first column, with their respective import prices in the second column. These are the international prices prevailing in 1987/88. Next the marketing margin from imports to retail is given, which is taken from Lodhi. The fourth column shows the losses from imports, which is either given in Lodhi, or was derived from Table AII.4 in the earlier section. The losses are usually lower because the products imported are more highly processes: wheat is threshed wheat but has not been milled; sugar is refined sugar, not cane; pulses have been shelled and cleaned; imported edible oils are not oilseeds but oil; and milk is usually in a highly processed form. Perhaps most interesting are the implications of the marketing margins in imports. Clearly, the costs of imported wheat are higher than the domestic sales price because of the negative marketing margins. With that, the price drops as it moves through the marketing chain, implying a subsidy.

All other products have lower international than domestic retail prices, so there are positive costs through the marketing system to get to reilsa. This does not necessarily indicate that marketing costs are what they would be in the absence of subsidies, but they still leave positive costs. Generally, it is contended that sugar is subsidized and inefficiently produced in Pakistan. This was not seen for 1987/88, which may have been an abnormal year. The prices for soybean and palm oil are inclusive of the equalizing duty on palm, which makes it the same landed price as soybean oil, although in reality there is a price differential in the international market.

The export figures are included in Table AII.27 as well. Five products are exported and are shown in the first column in the bottom half of the table. These are followed by the export prices and domestic farmgate prices. For imports, all of the marketing margins came from Lodhi, but exports were not included in that analysis. The technique was to simply deduct the domestic farmgate price at some intermediate part of Pakistan (generally Hyderabad) from the international price, to get an average difference between international and domestic prices. This marketing margin would then take any non-tariff barriers into account and also an average transport and distribution cost. Comparing wholesale prices for each of these products would show that a good part of rice and cotton products have some implicit export tariffs.

TABLE AII. 28: IMPORT AND EXPORT PRICES AND MARKETING MARGINS, PASM MODEL

Imports	Import Price	M M (Rs/Kg)	Conversion Factor	Net M M (Rs/Kg)
Sugar	3.22	-2.9	.97	-2.81
Pulses	3.94	5.63	.95	5.349
Soyo	5.00	8.15	.98	7.99
Palmo	5.00	8.15	.98	7.99*
Milk	1.80	5.98	1.00	5.98

* To Vegetable Ghee, To Liquid Oil, the margin is 9.40 Rs. 1 Kg.

Exports	Export Price	Farmputs	M M (1) - (2)	Conversion	Net M M
BAS Rice	12.751	7463	5288	.99	5235
Other Rice	3618	2586	1032	.99	1022
Veg	5298	2550	2748	.91	2500
Fru	6172	2960	3212	.87	2794
CTF	34786	14614	20172	.93	18760

ANNEX III

THE RIGHT HAND SIDE VALUE FOR THE PASM EQUATIONS (ROWS)

This annex describes the sources of data and calculations made to create the right hand sides values for each of the equations. Essentially this describes the resources available to the different sizes of farm, zones and regions in the model. The annex is therefore structured to show the right hand side values which are differentiated by size of farm, then those which are unique to each zone, and finally, the resources which are only constrained at the national level. The discussion in this annex pertains only to those equations which have non-zero right hand side values, or those equations which are resource restrictions equations. The equations with the zero values on the right hand side are all supply and demand rows. The nature of these rows has been described in the main text and the listings in Annexes VI and VII. They are not discussed here.

Farm Level right hand side values: Land, family labor, crop rotation, and market surplus right hand side values.

Land and crop rotation resource restrictions. Each size of farm has a certain amount of land available to it. Furthermore, it must obey certain crop rotation restrictions as well. The distribution of farm sizes in each zone was established using the 1980 Agricultural Census for use in the Economic Analysis Network's Farm Income Analysis. The proportions of cropped are for each crop done by each size of farm in that year was assumed to remain the same throughout the decade, so the area available to each size of farm in each zone was based on total cropped area and its remain based on the Census values. While perhaps a large assumption, this can be rectified by updating the mode to 1900-91 to take the new census values into account. The resulting values enter the model for each size of farm and zone are shown in Table A3.1 on the following pages.

Crop rotation restrictions are based on the commonly recognized problem of planting early wheat after either cotton or basmati rice. Planting these crops in kharif means that full-term wheat cannot be planted in rabi. A typical restriction would like the following:

$$PS1RIB + PS1CO4 + PS1WHE <= 250$$

The three terms indicate production by small farms in Zone 1, the rice zone of the Punjab, of Basmati rice, four picking cotton and wheat, respectively. The equation says that the sum of the area in production of these three crops cannot be greater than the total land available to those small farms in the rabi season. A more intuitive way to see the implications of this restrictions is to transfer the first two terms onto the right hand side:

$$PS1WHE <= 250 - PS1RIB - PS1CO4$$

This shows that the land put into early planting of wheat cannot be greater than the total land in rabi less what was put into basmati rice and four picking cotton in kharif. In other words, wheat can only be grown in rabi where basmati rice and cotton were not grown. (Got to check this one. All cotton or just 4-pick). Thus all crop rotation restrictions have the same values on the right hand side as the land available to each size of farm in the rabi season.

Family Labor.

ANNEX IV

ESTIMATION OF SELECTED CO-EFFICIENTS FOR PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

Estimation of Selected Coefficients for Pakistan Agricultural Sector Model (PASM)

Estimation of Pakistan Agricultural Sector Model (PASM) required specification of inter-linkages among different activities in Pakistan's agricultural sector. The following sections elaborate the methodology used in developing the coefficients for those inter-linkages. In particular we try to expain the method of determining the cropping regions, acreage and output by size categories, and crop budgets and prices in different regions of Pakistan.

1. Crops by Season

Crop sector was grouped into ten categories in Kharif and six categories in Rabi season. The Kharif season lasts from October to March while Rabi season is from April to September. The Kharif crops included in the model are: rice basmati, rice others, cotton, sugarcane, traditional Kharif oilseeds, non-traditional Kharif oilseeds, pulses, fodders, vegetables, and jowar/bajra/guarseed. The traditional Kharif oilseeds include groundnut, sesamum, linseed, and castorseed. The pulses in this season include mong, mash, and other pulses, whereas Kharif vegetables include chilies, turmeric, and "Other Kharif Vegetables". The Rabi crop categories are: wheat, barley, high value added crops, coarse grain, traditional Rabi oilseeds, non-traditional Rabi oilseeds and fodder. The high value added crops include tobacco and Rabi vegetables namely sugarbeet, onion, potato, coriander, and garlic. Traditional Rabi oilseeds include rapeseed and mustard, whereas Rabi pulses include peas, masoor and "Other pulses". The non-traditional oilseeds namely sunflower, safflower, and soyabeens are divided equally between Rabi and Kharif seasons.

For Rabi season, the area under the category of "other crops" (reported in the Agricultural Census, 1980) was added proportionately into the area for all Rabi crops. This was done to facilitate the disaggregating of the area by size category.

All the fruits were treated as annual crops. Area under these was, therefore, not broken down by seasons.

2. Cropping Zones

Assuming different crop production technology for different crop zones, the country is divided into eight zones. Punjab (excluding Barani districts of Rawalpindi, Jehlum and Attock) is divided into three crop zones; Sind and NWFP each into two; and Baluchistan as a whole is taken as one zone. Per hectare input requirements and yield for a given crop are assumed to be same within a zone.

The three zones in Punjab are titled as Rice, Sugarcane, and Cotton named respectively after the dominant crop grown in them. Similarly for Sind they have been titled as Cotton, and the Rice zones whereas the province of NWFP has been divided into Irrigated and Non-irrigated (barani) zones. The latter zone include districts with irrigated area being less than 50%. All the rest

were made part of the Irrigated zone. Districts of Rawalpindi, Jehlum and Attock, having 90% of the area as un-irrigated, were lumped into the NWFP barani-zone.

The districts used in defining our zones were those for the year 1980 (the year of the Census of Agriculture 1980.) Districts created since that year were merged with their parent districts for estimating data used in our model.

Table 1 shows zonal classification of districts in Sind, Punjab and NWFP and their shares in cropped area under major crops.

Figure 1 shows the location of zone in various provinces.

3. Specification of Farm-Size Categories

Crop production technologies are assumed to differ by size category. Accordingly the farms have been divided into three size categories. They are: (1) Small Farms, operating less than 5 hectares of land; 2) Medium Farms, operating from 5 to 10 hectares of land; and 3) Large Farms, having 10 or more than 10 hectares of land. These size categories conform with those used in the Pakistan Census of Agriculture 1980, Agricultural Statistics of Pakistan and several other sources of data on Pakistan agriculture.

4. Area by Size Category

Since the statistical source used to get information on cropped area, namely Agricultural Statistics of Pakistan, did not report area by size category, this had to be calculated by using some of the data from the 1980 Census of Agriculture. Accordingly we took the area under various crops from Agriculture Statistics and the shares of different size categories for each crop from the agricultural census. It was assumed that the shares of respective farm categories remained constant between 1980 and 1987-88.[1]

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1 Although this is a somewhat unrealistic assumption but in the absence of any evidence on change in the cropping pattern by farm category over time any other assumption could not have fared better either.

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Table 1. Classification of Crop Zones in Punjab and Sind, 1990

District	% Cropped Area Under:			
	Rice	Cotton	Sugarcane	Maize/Jawar
SIND				
Rice-Zone				
Badin	73	16	---	---
Thatta	88	1	---	---
Karachi	9	7	---	---
Dadu	64	5	---	---
Larkana	99	0	---	---
Shikarpur	99	0	---	---
Jaccobabad	99	0	---	---
Cotton-Zone				
Tharparkar	1	16	---	---
Hyderabad	27	57	---	---
Sanghar	1	85	---	---
Mawabshah	2	70	---	---
Khairpur	2	74	---	---
Sukkur	7	68	---	---
PUNJAB				
Rice-Zone				
Gujrat	72	7	18	3
Sialkot	87	3	5	5
Gujranwala	95	2	3	0
Sheikhupura	89	3	5	3
Lahore	76	3	16	5
Kasur	51	34	14	1
Sugarcane-Zone				
Sargodha*	29	24	30	17
Faisalabad	17	26	35	22
Cotton-Zone				
Sahiwal	28	52	13	7
Multan	7	85	7	1
Vehari	9	78	10	3
Muzaffargarh	14	65	20	1
D.G. Khan	37	58	4	1
Bahawalpur	9	74	15	2
Rahim Yar Khan	8	73	16	3
Bahawalnagar	16	66	17	1
Mianwali	0	72	26	2
Jhang	24	54	17	5

Table 1. Continued Classification of Crop Zones in Punjab and Sind, 1990

District	% Cropped Area Under:			
	Rice	Cotton	Sugarcane	Maize/Jawar
NWFP+PUNJAB BARANI				
Barani-Zone				
Attock	1	0	1	98
Rawalpindi	1	2	0	97
Attock	4	2	0	94
IRRIGATED				
Peshawar	NA	NA	NA	NA
Mardan	NA	NA	NA	NA

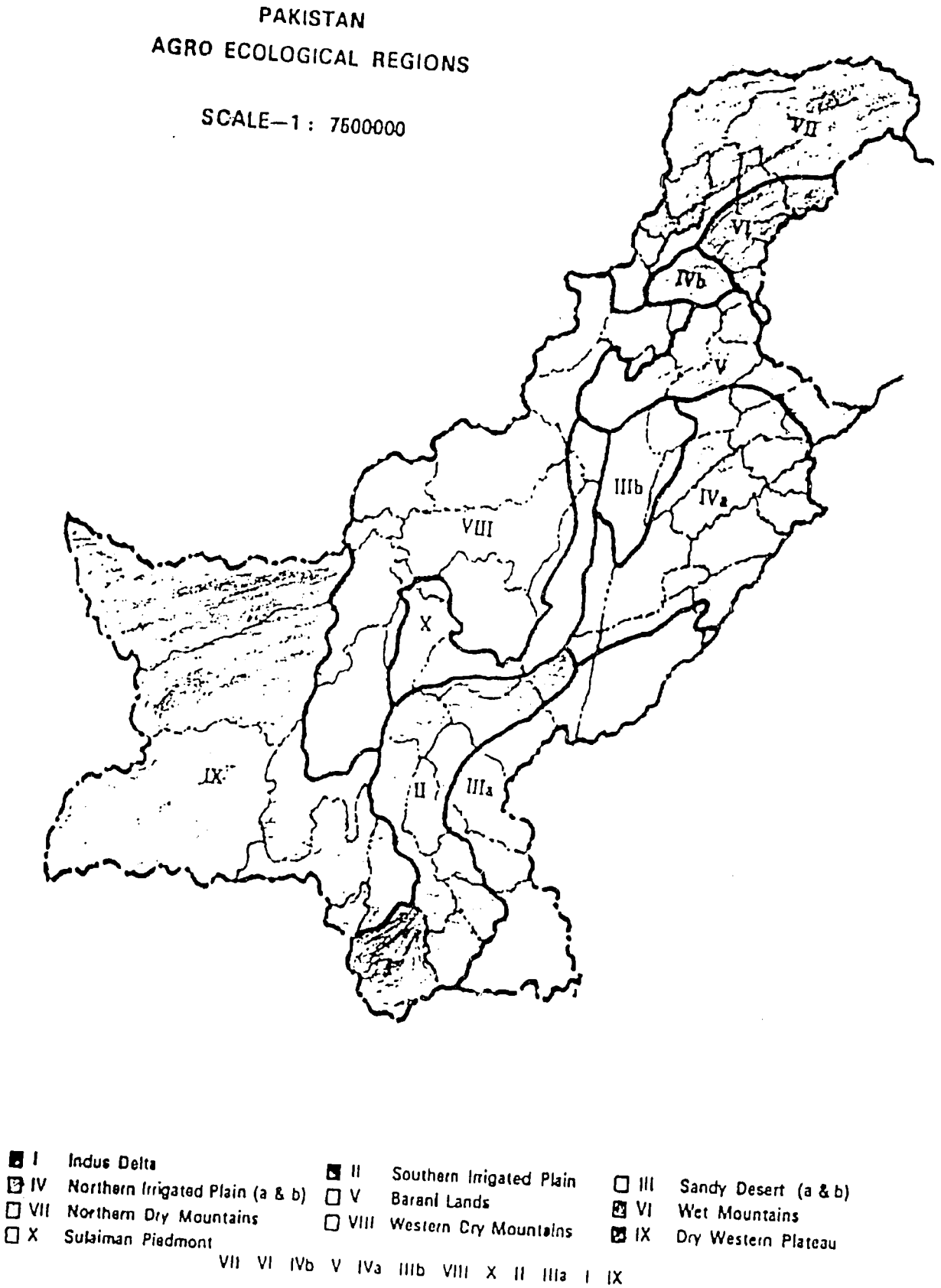
Source: Census of Agriculture 1980: Sind and Punjab.

* The crop-shares for Sargodha district are taken from acreage data reported in Agricultural Statistics of Pakistan 1983, because cropping pattern given in Pakistan Census of Agriculture 1980, does not match with the latest changes in cropping pattern in this district, especially increase in sugarcane area and decrease in cotton acreage.

\- Zero or negligible area.

NA: Not applicable, because the basis of definingthis zone is not the area under various crops.

Figure 1 Map of Pakistan with Crop Zone Specification
(The Cropping Zones of Pakistan)



Multiplying the latter with the former (for each district) gave us the 1987-88 distribution of cropped area for each crop by size category. The district information was then suitably grouped for zones in Punjab, Sind, and NWFP. For Baluchistan, obviously the provincial level size-category share had to be used to calculate the required information.

Table 2 shows the estimates of the cropped area by farm size and zone.

Relevant data to calculate livestock production by farm size were not available from any source. Therefore the pattern of estimates done for the crop sector could not be adopted for the livestock sub-sector.

5. Yield Distribution by Size Category

Based on a study of farm accounts and family budget in Punjab,[2] a comparison in yields (expressed in standardized units) of small, medium, and large farms for different crops are shown in Table 3. For crops not listed in the table the yield distribution is assumed to be equal to those of the nearest possible crops. Recognising the need to incorporate the regional specific, time specific and crop specific yield distribution data, the model is specified to include those data readily wherever they are available.

6. Production by Size Category and Yield Adjustment

Since the data on production are not reported by size category, they had to be estimated for the model. For this purpose we first took the average yield of a crop in a zone and multiplied the same with the standardised yield units for different farm categories in Table 3. The yields figures so obtained were then multiplied with area under crops held by given farms. This exercise enabled us to calculate what may be called the 'unadjusted production by farm categories'. However, the unadjusted production figures, when added up over all sizes, might not match with the reported production statistics. An adjustment factor was therefore calculated by dividing the reported production with the unadjusted one. Dividing the unadjusted yields of all size categories, by the adjustment factor gave us the adjusted yield figures. These were then multiplied with the area under various farms to produce the required estimates of production by size category. The adjusted production by size category, when added over all sizes, matches with the reported production for a given zone.

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2 Economic Analysis Network (EAN), Farm Accounts, Family Budgets of Rural Families and Cost of Production of Major Crops in Punjab, 1987-88, Islamabad.

Table 3. **A Comparative Yield Profile of Different Farm Categories in Punjab, 1987-88*.**

Crops	Small	Medium	Large
Basmati Rice	1.00	1.05	1.05
Course Rice	1.00	1.05	1.05
Maize	1.00	1.05	1.05
Jowar	1.00	1.27	1.26
Cotton	1.00	0.97	0.95
Sugarcane	1.00	0.99	1.07
Oilseed-Kharif	1.00	1.04	1.01
Pulses-Kharif	1.00	0.77	1.22
Vegetables	1.00	0.77	1.22
Gowarseed	1.00	0.92	0.74
Fodder-Kharif	1.00	0.95	0.90
Fruits	1.00	0.95	0.90
Wheat	1.00	1.01	1.05
Barley	1.00	1.01	1.05
Tobbaco	1.00	0.95	0.92
Gram	1.00	1.01	1.05
Pulses-Rabi	1.00	0.77	1.22
Vegetables-Rabi	1.00	0.92	0.74
Oilseed	1.00	0.77	1.22
Fodder-Rabi	1.00	0.95	0.90

*Yield figures of medium and large farms are compared with a standardised unit of 1 representing yield level of small farms.

8. Crop Enterprize Budgets

The budget of an enterprize may be defined as the physical quantities of variable inputs used per unit of a fixed input. In the case of crop budgets, inputs used are calculated per hectare of land, while for livestock, they are worked out per unit of an average (but not standard) animal. Accordingly the crop budgets for Punjab were developed on the basis of a study called "The Impact of Mechanization on Productivity and Employment by Farm Size and Tenure for Different Ecological Zones: Economic Assesment of Various Levels of Mechanization". This study was conducted by United Consultants Limited (UCL) in 1987-88. The classification of different technologies in the study matches with the size categories in our model. For example, the average sizes of the bullock technology, tractor technology, and 'tractor plus thresher' technology specified in the study are less than 4 hectares, 8 hectares, and 15 hectares, respectively. Our model also follows the same size classification. Wherever the crop budgets

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were not available from UCL study, other sources were relied upon. Those sources include the crop budgets developed by the government of Punjab for an average farm; Farm Management Mannual, developed by Dr. Bashir Ahmad in collaboration with CIMMYT and different 'Cost of Production Studies' done independently by Economic Wing of the Ministry of Food and Agriculture, the Punjab Economic Research Institute and the University of Agriculture Faisalabad. Crop budgets for rice and cotton zones of Sind are exactly the same as those in their respective zones in Punjab[3]. In NWFP, crop budgets for irrigated zone were based on the budgets developed by the provincial government for an average farm. In some cases where such budgets were not available, they were assumed to be equal to those in other provinces. For Barani zone of NWFP, the crop budgets were assumed to be equal to those for barani zone of Punjab. In Baluchistan, the crop budgets are taken from provincial government estimates for the average farmer in that province[4].

The following sections explain various items of crop budgets.

8.1 Fertilizer

The base quantities of fertilizer used for various crops in different zones are reported in Table 4. The reliability of these coefficients will improve if they are consistent with the total fertilizer supplies in a region. This is especially possible when the district level (in case of Punjab and Sind) and the province-wise fertilizer supplies for each month are known. Hence, fertilizer coefficients in Table 4 were adjusted with an adjustment factor, calculated as a ratio beween total quantities of fertilizer emerging from crop budgets and total supplies of fertilizer actually made to a zone in a given reason.

In table 4 we also show yields and yield/fertilizer rations for various crops by farm categories. These figures serve another check on the quality of fertilizer coefficients as generally one expected the yield to have positive relationship with the fertilizer use. Any "abnormal" value in the set at yield/fertilizer ratios would make the fertilizer coefficients soemwhat less reliable. This is however not to suggest that all yield/fertilizer ratios would be of the same order of

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3 This was done in view of the disturb political situation in Sind which hindered our data collection process in Sind.

4 The Economic Analysis Network project is sponsoring a study in all the provinces to update the crop budgets in different zones every year. This will improve the reliability as well as coverage of the crop budgets.

magnitude. They are most likely to vary across farm but it should not be different to values form the unexpected ones.

Data on supplies of fertilizers by region and season are also used as right hand side constraints in the model.

8.2 Seeds

The quantities of seeds used per hectare are also based on UCL report referred to earlier. In cases where the report did not help, the required information was taken from other sources. While calculating these data, it was assumed that the seed requirement (kg/ha) for barley was equal to that for wheat; for oilseeds it was same in both Rabi and Kharif seasons; jawar and bajra were similar to maize; and that all kinds of pulses had the same seed requirements.

In our estimates we have ignored differences in potential yields and costs for traditional and improved varieties to keep the analysis within the manageable limits. The estimated seed requirements for various crops are reported in Table 5.

8.3 Pesticides

Little information regarding pesticide use in a desirable format was available. The Agriculture Statistics of Pakistan provides information on the percentage of area treated with pesticides by crops and by province as well as the frequency of sprays. The average per hectare treated area of a crop was calculated by multiplying the number of sprays on treated area with proportion of total area treated. The average per hectare cost of pesticides in a province was estimated by multiplying the per hectare treated

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Table 4

Fertilizer Use, Yields, and Yield/Fertilizer Ratios by Crop and Zone in Pakistan, 1987-88

Rice Basmati

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	68.4	41.2	60.7	972	1024	1018	14.2	24.9	16.8
	2	35.3	54.9	76.3	947	998	993	26.9	18.2	13.0
	3	33.0	43.0	36.3	1069	1126	1121	32.4	26.2	30.9
	4	0.0	0.0	0.0				NA	NA	NA
	5	0.0	0.0	0.0				NA	NA	NA
	6	19.8	19.8	19.8	1530	1610	1602	77.1	81.2	80.7
	7	89.3	53.8	79.2	1043	1095	1095	11.7	20.4	13.8
	8	46.9	61.0	51.5	1451	1527	1519	31.0	25.0	29.5
PHO										
	1	16.7	7.7	14.0	972	1024	1018	58.3	132.9	72.7
	2	1.5	13.6	10.9	947	998	993	642.8	73.6	91.0
	3	3.6	8.4	6.8	1069	1126	1121	299.7	134.0	165.0
	4							NA	NA	NA
	5							NA	NA	NA
	6	8.4	8.4	8.4	1530	1610	1602	182.0	191.5	190.5
	7	36.7	17.0	30.9	1043	1095	1095	28.4	64.5	35.5
	8	6.1	14.3	11.5	1451	1527	1519	239.6	107.0	131.8
POT.										
	1			7.6	972	1024	1018	NA	NA	134.1
	2		6.7		947	998	993	NA	149.4	NA
	3		67.4		1069	1126	1121	NA	16.7	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6				1530	1610	1602	NA	NA	NA
	7			19.1	1043	1095	1095	NA	NA	57.4
	8	5.9	8.8	14.7	1451	1527	1519	247.5	173.4	103.4

NA: Absence of relevant data does not allow the estimation of this ratio.
PHO: Phosphate
POT: Potash

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

K H A R I F C R O P

Rice Other

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	44.4	21.0	68.3	2113	2223	2211	47.6	105.8	32.4
	2	38.4	38.4	38.4	2203	2318	2307	57.4	60.4	60.1
	3	33.2	0.0	33.2	1714	1803	1794	51.6	NA	54.0
	4	20.5	9.7	31.6	2411	2537	2525	117.4	261.0	79.9
	5	28.9	0.0	28.9	1460	1536	1528	50.5	NA	52.9
	6	23.1	23.1	28.9	3553	3739	3720	153.9	162.0	128.9
	7	57.9	27.4	89.2	3965	4164	4164	68.4	151.8	46.7
	8	47.1	0.0	47.1	2168	2277	2277	46.0	NA	48.3
PHO										
	1	9.9	4.1	12.4	2113	2223	2211	212.6	536.7	178.0
	2	6.8	6.8	6.8	2203	2318	2307	325.0	342.0	340.3
	3	5.4	0.0	5.4	1714	1803	1794	318.6	NA	333.5
	4	7.7	3.2	9.7	2411	2537	2525	311.9	787.8	261.4
	5	7.8		7.8	1460	1536	1528	188.4	NA	197.2
	6	16.8	16.8	0.0	3553	3739	3720	211.3	222.3	NA
	7	21.9	9.1	27.4	3965	4164	4164	181.0	456.2	152.1
	8	9.1	0.0	9.1	2168	2277	2277	237.5	NA	249.4
POT.										
	1			5.8	2113	2223	2211	NA	NA	378.4
	2	6.2	6.2	6.2	2203	2318	2307	353.7	372.2	370.3
	3	16.9		16.9	1714	1803	1794	101.7	NA	106.4
	4			5.4	2411	2537	2525	NA	NA	471.0
	5	27.8		27.8	1460	1536	1528	52.5	NA	55.0
	6				3553	3739	3720	NA	NA	NA
	7			14.7	3965	4164	4164	NA	NA	283.6
	8	4.4	3.7	3.7	2168	2277	2277	489.9	620.7	620.7

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

K H A R I F C R O P

Maize

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	26.9	26.9	26.9	474	556	493	17.6	20.7	18.3
	2	44.7	56.3	60.7	874	918	909	19.6	16.3	15.0
	3	55.5	99.6	38.6	662	695	689	11.9	7.0	17.8
	4	12.5	12.5	12.5	307	314	321	24.6	25.2	25.8
	5	48.3	86.7	33.6	359	378	376	7.4	4.4	11.2
	6	11.2	12.0	15.4	408	518	513	36.5	43.1	33.3
	7	42.0	42.0	42.0	1684	1767	1751	40.1	42.1	41.7
	8	27.4	27.4	27.4	706	741	734	25.7	27.0	26.8
PHO										
	1	12.4	12.4	12.4	474	556	493	38.1	44.7	39.7
	2	13.6	14.0	13.6	874	918	909	64.5	65.7	67.1
	3	10.8	16.1	10.8	662	695	689	61.6	43.1	64.0
	4	9.7	9.7	9.7	307	314	321	31.7	32.5	33.2
	5	15.5	23.2	15.5	359	378	376	23.2	16.2	24.3
	6	4.3	1.0	5.0	408	518	513	94.6	520.4	102.8
	7	10.3	10.3	10.3	1684	1767	1751	163.2	171.3	169.7
	8	9.1	9.1	9.1	706	741	734	77.3	81.2	80.4
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

K H A R I F C R O P

Cotton-3-picking

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	59.9	59.9	59.9	164	162	175	2.7	2.7	2.9
	2	57.7	85.9	100.6	284	281	303	4.9	3.3	3.0
	3	74.4	89.2	103.4	768	760	820	10.3	8.5	7.9
	4	27.2	27.2	27.2	199	193	189	7.3	7.1	7.0
	5	63.2	75.7	88.8	358	348	340	5.7	4.6	3.8
	6							NA	NA	NA
	7	82.3	82.3	82.3	200	198	214	2.4	2.4	2.6
	8	82.3	82.3	82.3	32	32	34	0.4	0.4	0.4
PHO										
	1	11.8	11.8	11.8	164	162	175	13.9	13.7	14.8
	2	19.3	24.0	24.1	284	281	303	14.7	11.7	12.6
	3	20.4	18.9	21.4	768	760	820	37.6	40.2	38.4
	4	10.7	8.6	8.7	199	193	189	18.7	22.4	21.8
	5	28.0	26.7	28.4	358	348	340	12.8	13.0	12.0
	6							NA	NA	NA
	7	27.4	27.4	27.4	200	198	214	7.3	7.2	7.8
	8	27.4	27.4	27.4	32	32	34	1.2	1.2	1.2
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

Cotton-4-picking

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	65.8	65.8	65.8	180	178	192	2.7	2.7	2.9
	2	63.5	94.5	110.7	312	309	333	4.9	3.3	3.0
	3	81.9	98.1	113.8	845	836	902	10.3	8.5	7.9
	4	31.2	31.2	31.7	219	212	208	7.0	6.8	6.6
	5	73.2	87.7	100.8	394	382	374	5.4	4.4	3.7
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA
PHO										
	1	13.0	13.0	13.0	180	178	192	13.9	13.7	14.8
	2	21.3	26.4	26.5	312	309	333	14.7	11.7	12.6
	3	22.5	20.8	23.5	845	836	902	37.6	40.2	38.4
	4	8.7	10.7	10.7	219	212	208	25.3	19.9	19.5
	5	34.0	30.7	36.4	394	382	374	11.6	12.5	10.3
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

K H A R I F C R O P

Sugarcane

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	24.9	57.1	50.9	34280	35531	34533	1376.7	622.3	679.1
	2	44.7	97.2	101.1	38716	40129	39002	866.6	412.7	385.7
	3	87.2	124.5	177.5	32280	32280	32518	370.2	259.4	183.2
	4	11.5	26.4	23.5	44662	44226	47712	3876.9	1674.0	2027.7
	5	75.9	108.3	154.5	44855	44417	47918	590.8	410.1	310 1
	6	13.7	31.4	27.9	54054	54054	54054	3950.3	1722.7	1934.4
	7	74.6	74.6	74.6	41345	43000	41759	554.5	576.7	560.0
	8	74.6	74.6	74.6	30208	31417	30511	405.1	421.3	409.2
PHO										
	1	6.9	8.3	13.0	34280	35531	34533	4985.6	4289.1	2655.2
	2	13.6	28.7	29.3	38716	40129	39002	2855.7	1396.2	1331.9
	3	21.5	25.1	10.8	32280	32280	32518	1500.5	1288.0	3023.1
	4	5.4	6.4	10.1	44662	44226	47712	8348.0	6867.4	4714.6
	5	31.0	36.1	15.5	44855	44417	47918	1447.4	1230.4	3093.5
	6	14.0	16.8	26.4	54054	54054	54054	3872.4	3214.1	2047.2
	7	17.2	17.2	17.2	41345	43000	41759	2400.8	2496.9	2424.8
	8	17.2	17.2	17.2	30208	31417	30511	1754.1	1824.3	1771.7
POT.										
	1		11.7		34280	35531	34533	NA	3040.3	NA
	2		24.9		38716	40129	39002	NA	1610.4	NA
	3				32280	32280	32518	NA	NA	NA
	4		10.7		44662	44226	47712	NA	4125.6	NA
	5				44855	44417	47918	NA	NA	NA
	6	1.8	4.4	2.6	54054	54054	54054	30712.5	12285.0	20475.0
	7				41345	43000	41759	NA	NA	NA
	8	17.6		17.6	30208	31417	30511	1715.4	NA	1732.6

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

Oilseed-t

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	5.9	5.9	5.9	415	319	507	70.2	54.0	85.8
	2	6.3	6.3	6.3	885	681	681	140.9	108.4	108.4
	3	5.4	5.4	5.4	888	683	1085	163.4	125.7	199.7
	4	2.7	2.7	2.7	367	380	370	134.4	139.3	135.4
	5	4.7	4.7	4.7	1571	1628	1582	332.1	344.2	334.6
	6	3.2	3.2	3.2	396	305	484	122.1	93.9	149.3
	7	7.7	7.7	7.7	1253	1303	1265	162.4	168.8	163.9
	8	7.7	7.7	7.7	572	595	578	74.1	77.1	74.9
PHO										
	1	4.1	4.1	4.1	415	319	507	100.1	77.0	122.4
	2	6.8	6.8	6.8	885	681	681	130.6	100.5	100.5
	3	5.4	5.4	5.4	888	683	1085	165.0	126.9	201.7
	4	3.2	3.2	3.2	367	380	370	114.0	118.1	114.8
	5	7.8	7.8	7.8	1571	1628	1582	202.7	210.1	204.2
	6	8.4	8.4	8.4	396	305	484	47.1	36.3	57.6
	7	9.1	9.1	9.1	1253	1303	1265	137.3	142.8	138.6
	8	9.1	9.1	9.1	572	595	578	62.7	65.2	63.3
POT.										
	1	2.9	2.9	2.9				0.0	0.0	0.0
	2	12.5	12.5	12.5				0.0	0.0	0.0
	3	33.7	33.7	33.7				0.0	0.0	0.0
	4	2.7	2.7	2.7				0.0	0.0	0.0
	5	5.6	5.6	5.6				0.0	0.0	0.0
	6	1.1	1.1	1.1				0.0	0.0	0.0
	7	7.3	7.3	7.3				0.0	0.0	0.0
	8	7.3	7.3	7.3				0.0	0.0	0.0

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

Oilseed-nt

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	45.9	45.9	45.9	1098	845	1342	23.9	18.4	29.2
	2	48.9	48.9	48.9	1251	962	962	25.6	19.7	19.7
	3	42.8	42.3	42.3	998	768	1219	23.3	18.2	28.9
	4	6.1	6.1	6.1	617	639	621	101.6	105.3	102.4
	5	21.0	21.0	21.0	615	637	619	29.2	30.3	29.5
	6							NA	NA	NA
	7	60.0	60.0	60.0	683	649	614	11.4	10.8	10.2
	8	30.0	30.0	30.0	1083	833	1324	36.1	27.8	44.1
PHO										
	1	9.0	9.0	9.0	1098	845	1342	121.9	93.8	149.0
	2	14.7	14.7	14.7	1251	962	962	84.9	65.3	65.3
	3	11.7	11.7	11.7	998	768	1219	85.3	65.6	104.3
	4				617	639	621	NA	NA	NA
	5	10.8	10.8	10.8	615	637	619	57.0	59.1	57.4
	6							NA	NA	NA
	7	19.8	19.8	19.8	683	649	614	34.4	32.7	30.9
	8	9.9	9.9	9.9	1083	833	1324	109.1	84.0	133.4
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

Vegetables

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	162.8	162.8	162.8	16697	15398	12398	102.6	94.6	76.2
	2	173.1	173.1	173.1	16981	15659	12609	98.1	90.5	72.8
	3	149.7	149.7	149.7	14237	13129	10572	95.1	87.7	70.6
	4	75.3	75.3	75.3	3808	2930	4655	50.6	38.9	61.8
	5	130.3	130.3	130.3	1607	1236	1964	12.3	9.5	15.1
	6	89.4	89.4	89.4	13801	12726	10247	154.3	142.3	114.6
	7	212.6	212.6	212.6	17239	13273	15859	81.1	62.4	74.6
	8	212.6	212.6	212.6	14585	11231	13418	68.6	52.8	63.1
PHO										
	1	16.6	16.6	16.6	16697	15398	12398	1007.8	929.4	748.3
	2	27.1	27.1	27.1	16981	15659	12609	626.3	577.5	465.0
	3	21.5	21.5	21.5	14237	13129	10572	661.8	610.3	491.4
	4	12.9	12.9	12.9	3808	2930	4655	295.5	227.3	361.1
	5	31.0	31.0	31.0	1607	1236	1964	51.9	39.9	63.4
	6	33.6	33.6	33.6	13801	12726	10247	410.3	378.4	304.7
	7	36.5	36.5	36.5	17239	13273	15859	472.2	363.6	434.4
	8	36.5	36.5	36.5	14585	11231	13418	399.5	307.6	367.5
POT.										
	1	2.9	2.9		16697	15398	12398	5715.1	5270.2	NA
	2	12.5	12.5		16981	15659	12609	1362.9	1256.8	NA
	3	33.7	33.7		14237	13129	10572	422.3	389.4	NA
	4	2.7	2.7		3808	2930	4655	1421.1	1093.1	NA
	5	55.6	55.6		1607	1236	1964	28.9	22.2	NA
	6	1.1	1.1		13801	12726	10247	12546.1	11569.4	NA
	7	7.3	7.3	7.3	17239	13273	15859	2350.3	1809.6	2162.2
	8	7.3	7.3	7.3	14585	11231	13418	1988.5	1531.2	1829.3

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Fodder Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	30.2	30.2	30.2						
	2	32.1	32.1	32.1						
	3	27.8	27.8	27.8						
	4	14.0	14.0	14.0						
	5	24.2	24.2	24.2						
	6	8.3	8.3	8.3						
	7	39.4	39.4	39.4						
	8	39.4	39.4	39.4						
PHO										
	1	3.6	3.6	3.6						
	2	5.9	5.9	5.9						
	3	4.7	4.7	4.7						
	4	2.8	2.8	2.8						
	5	6.7	6.7	6.7						
	6	7.3	7.3	7.3						
	7	7.9	7.9	7.9						
	8	7.9	7.9	7.9						
POT.										
	1	0.5	0.5	0.5						
	2	2.0	2.0	2.0						
	3	5.4	5.4	5.4						
	4	0.4	0.4	0.4						
	5	8.9	8.9	8.9						
	6	0.2	0.2	0.2						
	7	1.2	1.2	1.2						
	8	1.2	1.2	1.2						

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

K H A R I F C R O P

Fruit

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	56.3	56.3	56.3	7404	7331	7909	131.4	130.1	140.4
	2	56.0	56.0	56.0	8735	8649	9331	156.0	154.5	166.7
	3	61.6	61.6	61.6	7906	7829	8446	128.3	127.0	137.0
	4	21.8	21.8	21.8	8138	7731	7324	373.3	354.6	336.0
	5	21.8	21.8	21.8	7975	7576	7177	365.8	347.5	329.2
	6	53.9	53.9	53.9	12960	12833	13845	240.4	238.0	256.8
	7	128.1	128.1	128.1	10249	10761	10659	80.0	84.0	83.2
	8	128.1	128.1	128.1	10901	11446	11337	85.1	89.3	88.5
PHO										
	1	23.1	23.1	23.1	7404	7331	7909	320.8	317.7	342.7
	2	23.0	23.0	23.0	8735	8649	9331	379.4	375.7	405.3
	3	23.4	23.4	23.4	7906	7829	8446	337.9	334.7	361.0
	4	6.7	6.4	6.4	8138	7731	7324	1207.4	1213.6	1149.8
	5	6.4	12.7	6.4	7975	7576	7177	1251.9	594.7	1126.7
	6	21.0	21.0	21.0	12960	12833	13845	616.2	610.2	658.3
	7	22.8	22.8	22.8	10249	10761	10659	449.1	471.6	467.1
	8	22.8	22.8	22.8	10901	11446	11337	477.7	501.6	496.8
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6	2.2	2.2	2.2	12960	12833	13845	5890.8	5833.2	6293.1
	7	14.7	14.7	14.7	10249	10761	10659	698.7	733.6	726.6
	8	14.7	14.7	14.7	10901	11446	11337	743.1	780.3	772.8

1= Punjab Rice
2= Punjab Sugarcane
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4= Sind Rice
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6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Wheat

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	51.1	50.4	57.8	1430	1445	1502	28.0	28.7	26.0
	2	35.5	75.6	67.9	1493	1510	1569	42.1	20.0	23.1
	3	79.2	96.8	99.0	1520	1537	1598	19.2	15.9	16.1
	4	232.9	229.8	262.1	1134	1148	1193	4.9	5.0	4.6
	5	117.7	146.2	149.6	1949	1970	2047	16.6	13.5	13.7
	6	12.1	12.1	12.1	1751	1769	1839	144.9	146.5	152.2
	7	21.8	31.4	53.0	1269	1283	1334	58.1	40.9	25.2
	8	22.8	23.2	23.2	731	739	768	32.1	31.9	33.2
PHO										
	1	19.6	18.7	22.2	1430	1445	1502	72.9	77.4	67.6
	2	14.5	32.1	27.4	1493	1510	1569	103.1	47.1	57.3
	3	33.5	28.1	33.2	1520	1537	1598	45.4	54.8	48.1
	4	58.0	58.7	69.9	1134	1148	1193	19.6	19.6	17.1
	5	27.5	24.2	28.3	1949	1970	2047	70.9	81.3	72.4
	6	5.9	5.9	5.9	1751	1769	1839	296.9	300.1	311.8
	7		7.8	10.1	1269	1283	1334	NA	163.6	132.2
	8	11.4	11.2	11.2	731	739	768	64.0	65.9	68.5
POT.										
	1			9.0	1430	1445	1502	NA	NA	166.6
	2		3.0	6.1	1493	1510	1569	NA	496.7	258.1
	3		6.7	3.3	1520	1537	1598	NA	230.8	479.8
	4			16.1	1134	1148	1193	NA	NA	74.0
	5		12.3	8.2	1949	1970	2047	NA	160.0	250.3
	6				1751	1769	1839	NA	NA	NA
	7				1269	1283	1334	NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
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6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Late Wheat

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	56.2	55.4	63.6	1358	1373	1427	24.2	24.8	22.4
	2	39.0	83.1	74.7	1419	1434	1491	36.3	17.3	20.0
	3	87.1	106.5	108.9	1444	1460	1518	16.6	13.7	13.9
	4	212.9	209.8	242.1	1078	1090	1311	5.1	5.2	5.4
	5	137.7	166.2	169.6	1851	1871	1945	13.4	11.3	11.5
	6	13.3	13.3	13.3	1925	1947	1747	144.9	146.5	131.5
	7	24.0	33.7	56.3	1039	1050	1092	43.2	31.2	19.4
	8	25.1	24.3	25.3	598	605	629	23.8	24.9	24.8
PHO										
	1	21.6	20.5	24.4	1358	1373	1427	63.0	66.9	58.4
	2	15.9	35.3	30.1	1419	1434	1491	89.1	40.7	49.5
	3	36.8	30.9	36.6	1444	1460	1518	39.2	47.3	41.5
	4	54.0	48.7	57.9	1078	1090	1311	20.0	22.4	22.7
	5	37.5	30.2	36.3	1851	1871	1945	49.4	61.9	53.6
	6	6.5	6.5	6.5	1925	1947	1747	296.8	300.1	269.3
	7		9.0	11.2	1039	1050	1092	NA	117.1	97.4
	8	12.6	12.3	12.3	598	605	629	47.6	49.0	51.0
POT.										
	1			9.9	1358	1373	1427	NA	NA	143.9
	2		3.3	6.7	1419	1434	1491	NA	428.9	222.9
	3		7.3	3.7	1444	1460	1518	NA	199.4	414.4
	4			14.1	1078	1090	1311	NA	NA	92.9
	5		16.3	6.2	1851	1871	1945	NA	114.7	315.7
	6				1925	1947	1747	NA	NA	NA
	7				1039	1050	1092	NA	NA	NA
	8				598	605	629	NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
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4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Barley

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	16.6	21.6	24.9	644	651	676	38.8	30.2	27.2
	2	11.1	13.3	14.5	666	673	700	59.9	50.5	48.4
	3	13.3	17.2	19.9	583	589	613	43.9	34.2	30.8
	4	68.7	89.3	103.0	358	362	376	5.2	4.1	3.7
	5	20.3	26.4	30.5	433	438	455	21.3	16.6	14.9
	6				756	764	794	NA	NA	NA
	7	10.0	13.0	15.0	711	719	747	71.3	55.5	49.9
	8				570	577	599	NA	NA	NA
PHO										
	1				644	651	676	NA	NA	NA
	2				666	673	700	NA	NA	NA
	3				583	589	613	NA	NA	NA
	4				358	362	376	NA	NA	NA
	5				433	438	455	NA	NA	NA
	6				756	764	794	NA	NA	NA
	7				711	719	747	NA	NA	NA
	8				570	577	599	NA	NA	NA
POT.										
	1				644	651	676	NA	NA	NA
	2				666	673	700	NA	NA	NA
	3				583	589	613	NA	NA	NA
	4				358	362	376	NA	NA	NA
	5				433	438	455	NA	NA	NA
	6				756	764	794	NA	NA	NA
	7				711	719	747	NA	NA	NA
	8				570	577	599	NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
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7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

R A B I C R O P S

Rabi Pulses

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	7.5	7.5	7.5	278	281	292	37.2	37.6	39.1
	2	5.0	5.0	5.0	246	249	259	49.2	49.8	51.7
	3	6.0	6.0	6.0	272	275	286	45.5	46.0	47.8
	4	30.9	30.9	30.9	420	425	442	13.6	13.7	14.3
	5	9.2	9.2	9.2	464	469	488	50.7	51.3	53.3
	6		8.4	8.4	459	464	482	NA	55.3	57.5
	7	4.5	4.5	4.5	209	211	219	46.5	47.0	48.8
	8				114	115	120	NA	NA	NA
PHO										
	1	9.8	10.2	9.8	278	281	292	28.3	27.4	29.7
	2	7.6	7.6	7.6	246	249	259	32.3	32.7	34.0
	3	8.4	8.4	8.4	272	275	286	32.4	32.7	34.0
	4	26.9	26.9	26.9	420	425	442	15.7	15.8	16.4
	5	7.7	7.7	7.7	464	469	488	59.9	60.6	63.0
	6		2.9	2.9	459	464	482	NA	157.7	163.9
	7	5.4	5.4	5.4	209	211	219	38.3	38.7	40.2
	8				114	115	120	NA	NA	NA
POT.										
	1				278	281	292	NA	NA	NA
	2				246	249	259	NA	NA	NA
	3				272	275	286	NA	NA	NA
	4				420	425	442	NA	NA	NA
	5				464	469	488	NA	NA	NA
	6				459	464	482	NA	NA	NA
	7				209	211	219	NA	NA	NA
	8				114	115	120	NA	NA	NA

1= Punjab Rice
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5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Rabi Vegetables

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	144.2	144.2	144.2	5127	4728	3807	35.5	32.8	26.4
	2	96.7	96.7	96.7	6930	6391	5146	71.7	66.1	53.2
	3	129.1	152.6	141.3	5960	5496	4425	46.2	36.0	31.3
	4	597.6	597.6	597.6	8214	7574	6099	13.7	12.7	10.2
	5	197.8	233.8	216.5	8683	8007	6447	43.9	34.2	29.8
	6	45.6	45.6	45.6	14236	13128	10571	312.5	288.1	232.0
	7	86.8	86.8	86.8	2276	2094	1684	26.2	24.1	19.4
	8	86.8	86.8	86.8	6839	6292	5061	78.8	72.5	58.3
PHO										
	1	39.3	39.3	39.3	5127	4728	3807	130.4	120.3	96.8
	2	30.5	30.5	30.5	6930	6391	5146	227.4	209.7	168.8
	3	50.0	58.7	53.7	5960	5496	4425	119.2	93.7	82.4
	4	107.4	107.4	107.4	8214	7574	6099	76.5	70.5	56.8
	5	46.1	54.1	49.5	8683	8007	6447	188.4	148.1	130.2
	6	11.8	11.8	11.8	14236	13128	10571	1210.6	1116.4	898.9
	7	21.8	21.8	21.8	2276	2094	1684	104.5	96.2	77.3
	8	21.8	21.8	21.8	6839	6292	5061	314.1	288.9	232.4
POT.										
	1	10.4	10.4	10.4	5127	4728	3807	494.4	455.9	367.1
	2	6.4	6.4	6.4	6930	6391	5146	1082.9	998.6	804.1
	3			10.5	5960	5496	4425	NA	NA	420.9
	4	17.6	17.6	17.6	8214	7574	6099	466.2	429.9	346.1
	5			21.5	8683	8007	6447	NA	NA	300.3
	6	3.3	3.3	3.3	14236	13128	10571	4340.3	4002.4	3222.7
	7	32.5	32.5	32.5	2276	2094	1684	70.1	64.5	51.9
	8	32.5	32.5	32.5	6839	6292	5061	210.7	193.8	155.9

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Traditional Oilseeds

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	53.0	53.0	53.0	894	688	1093	16.9	13.0	20.6
	2	35.6	35.6	35.6	885	681	681	24.9	19.1	19.1
	3	42.5	42.5	42.5	989	761	1208	23.3	17.9	28.5
	4	219.8	219.8	219.8	526	404	643	2.4	1.8	2.9
	5	65.1	65.1	65.1	592	455	723	9.1	7.0	11.1
	6	16.8	16.8	16.8	651	501	795	38.8	29.9	47.5
	7	31.9	31.9	31.9	1235	1136	914	38.7	35.6	28.6
	8	31.9	31.9	31.9	493	453	364	15.4	14.2	11.4
PHO										
	1	19.7	19.7	19.7	894	688	1093	45.5	35.0	55.6
	2	15.2	15.2	15.2	885	681	681	58.1	44.7	44.7
	3	16.8	16.8	16.8	989	761	1208	58.9	45.3	72.0
	4	53.7	53.7	53.7	526	404	643	9.8	7.5	12.0
	5	15.5	15.5	15.5	592	455	723	38.3	29.4	46.8
	6	5.9	5.9	5.9	651	501	795	110.7	85.1	135.3
	7	10.9	10.9	10.9	1235	1136	914	113.4	104.3	83.9
	8	10.9	10.9	10.9	493	453	364	45.3	41.6	33.4
POT.										
	1				894	688	1093	NA	NA	NA
	2				885	681	681	NA	NA	NA
	3				989	761	1208	NA	NA	NA
	4				526	404	643	NA	NA	NA
	5				592	455	723	NA	NA	NA
	6				651	501	795	NA	NA	NA
	7				1235	1136	914	NA	NA	NA
	8				493	453	364	NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Non-Traditional Oilseeds

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	58.0	58.0	58.0	1076	828	1315	18.5	14.3	22.7
	2	38.9	38.9	38.9	1079	830	1319	27.7	21.3	33.9
	3	46.4	46.4	46.4	1053	810	1288	22.7	17.5	27.7
	4	68.7	68.7	68.7	616	639	621	9.0	9.3	9.0
	5	40.7	40.7	40.7	616	638	620	15.1	15.7	15.3
	6				0	0	0	NA	NA	NA
	7	34.9	34.9	34.9	540	513	486	15.5	14.7	13.9
	8	17.5	17.5	17.5	521	495	469	29.9	28.4	26.9
PHO										
	1	21.4	21.4	21.4	1076	828	1315	50.4	38.8	61.6
	2	16.6	16.6	16.6	1079	830	1319	65.1	50.1	79.6
	3	18.2	18.2	18.2	1053	810	1288	57.7	44.4	70.6
	4	23.3	23.3	23.3	616	639	621	26.4	27.4	26.6
	5	10.8	10.8	10.8	616	638	620	57.2	59.3	57.7
	6				0	0	0	NA	NA	NA
	7	11.8	11.8	11.8	540	513	486	45.6	43.3	41.1
	8	5.9	5.9	5.9	521	495	469	88.0	83.7	79.3
POT.										
	1				1076	828	1315	NA	NA	NA
	2				1079	830	1319	NA	NA	NA
	3				1053	810	1288	NA	NA	NA
	4				616	639	621	NA	NA	NA
	5				616	638	620	NA	NA	NA
	6				0	0	0	NA	NA	NA
	7				540	513	486	NA	NA	NA
	8				521	495	469	NA	NA	NA

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

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Table 4

R A B I C R O P S

Rabi Fodder

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	38.1	38.1	38.1						
	2	25.6	25.6	25.6						
	3	30.5	30.5	30.5						
	4	158.0	158.0	158.0						
	5	46.8	46.8	46.8						
	6									
	7	10.9	10.9	10.9						
	8	10.9	10.9	10.9						
PHO										
	1	8.5	8.5	8.5						
	2	6.6	6.6	6.6						
	3	7.3	7.3	7.3						
	4									
	5	6.7	6.7	6.7						
	6	2.6	2.6	2.6						
	7	2.6	2.6	2.6						
	8	2.6	2.6	2.6						
POT.										
	1	0.4	0.4	0.4						
	2	0.3	0.3	0.3						
	3	0.3	0.3	0.3						
	4	0.7	0.7	0.7						
	5	0.6	0.6	0.6						
	6	0.1	0.1	0.1						
	7									
	8									

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 4

R A B I C R O P S

Fruit

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	102.4	102.4	102.4	7404	7331	7909	72.3	71.6	77.2
	2	79.7	79.7	79.7	8735	8649	9331	109.6	108.5	117.0
	3	93.2	93.2	93.2	7906	7829	8446	84.8	84.0	90.6
	4	21.8	21.8	21.8	8138	7731	7324	373.3	354.6	336.0
	5	21.8	21.8	21.8	7975	7576	7177	365.8	347.5	329.2
	6	38.8	38.8	38.8	12960	12833	13845	334.3	331.0	357.1
	7	74.8	74.8	74.8	10249	10761	10659	136.9	143.8	142.4
	8	74.8	74.8	74.8	10901	11446	11337	145.6	152.9	151.5
PHO										
	1	114.5	114.5	114.5	7404	7331	7909	64.7	64.0	69.1
	2	91.1	91.1	91.1	8735	8649	9331	95.9	95.0	102.5
	3	111.0	111.0	111.0	7906	7829	8446	71.2	70.5	76.1
	4	6.7	6.4	6.4	8138	7731	7324	1207.4	1213.6	1149.8
	5	6.4	6.4	6.4	7975	7576	7177	1251.9	1189.3	1126.7
	6	7.4	7.4	7.4	12960	12833	13845	1760.8	1743.6	1881.1
	7	13.6	13.6	13.6	10249	10761	10659	752.7	790.3	782.8
	8	13.6	13.6	13.6	10901	11446	11337	800.6	840.6	832.6
POT.										
	1				7404	7331	7909	NA	NA	NA
	2				8735	8649	9331	NA	NA	NA
	3				7906	7829	8446	NA	NA	NA
	4				8138	7731	7324	NA	NA	NA
	5				7975	7576	7177	NA	NA	NA
	6	1.7	1.7	1.7	12960	12833	13845	7714.1	7638.7	8240.9
	7	16.2	16.2	16.2	10249	10761	10659	632.5	664.1	657.8
	8	16.2	16.2	16.2	10901	11446	11337	672.7	706.4	699.6

1= Punjab Rice
2= Punjab Sugarcane
3= Punjab Cotton
4= Sind Rice
5= Sind Cotton
6= Baluchistan
7= NWFP Irrigated
8= NWFP Unirrigated

Table 5. SEED USE (KG/PER HECTARE) FOR VARIOUS CROPS IN PAKISTAN, 1987-88

(a) Kharif Crops

CROP	Rice (B)			Rice (o)			Maize			Jowar (K.Fooder)			Cotton			Sugarcan		
ZONES	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
PUNJAB																		
RICE	10.2	8.8	8.8	12.4	14.8	14.8	32.4	32.4	32.4	64.2	60.3	65.2	19.8	19.8	19.8	3335.9	3583.0	3583.0
SUGARCANE	16.8	12.8	14.8	14.8	14.8	14.8	23.5	38.6	37.1	64.2	60.3	65.2	14.8	16.2	19.2	3276.2	3563.9	3500.6
COTTON	15.7	16.6	13.8	14.8	19.8	14.8	79.1	32.1	49.4	64.2	60.3	65.2	16.4	18.2	21.2	3552.1	3648.8	3459.4
BARANI	15.7	16.6	13.8	14.8	19.8	14.8	62.0	62.0	62.0	64.2	60.3	65.2	14.8	16.2	19.2	3335.9	3583.0	3583.0
SIND																		
RICE	---	---	---	12.4	14.8	14.8	32.4	32.4	32.4	64.2	60.3	65.2	19.8	19.8	19.8	3335.9	3583.0	3583.0
COTTON	---	---	---	14.8	19.8	14.8	79.1	32.1	49.4	64.2	60.3	65.2	16.4	18.2	21.2	3552.1	3648.8	3459.4
NWFP																		
IRRIGATED	10.2	8.8	8.8	12.4	14.8	14.8	49.4	49.4	49.4	64.2	60.3	65.2	19.8	19.8	19.8	3459.4	3459.4	3459.4
UN-IRRIGATED	15.7	16.6	13.8	14.8	19.8	14.8	61.8	61.8	61.8	64.2	60.3	65.2	19.8	19.8	19.8	3459.4	3459.4	3459.4
BALUCHISTAN	6.2	16.6	13.8	14.8	19.8	14.8	62.0	62.0	62.0	64.2	60.3	65.2	14.8	16.2	19.2	3335.9	3583.0	3583.0

Continued for Kharif Crops ...

CROP	Oilseed			Groundnut			Pulses (Mung)			Vegetables (Chillies)			Guarseed			Fodder		
ZONES	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
PUNJAB																		
RICE	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
SUGARCANE	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
COTTON	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
BARANI	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
SIND																		
RICE	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
COTTON	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	24.7	24.7	24.7			
NWFP																		
IRRIGATED	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	37.1	37.1	37.1			
UN-IRRIGATED	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	49.4	49.4	49.4	37.1	37.1	37.1			
BALUCHISTAN	32.0	32.0	32.0	16.6	16.6	16.6	4.9	4.9	4.9	24.7	24.7	24.7	24.7	24.7	24.7			

Table 5. Continued (b) Rabi Crops

CROP ZONES	Wheat S	Wheat M	Wheat L	Barley S	Barley M	Barley L	Tobacco S	Tobacco M	Tobacco L	Gram S	Gram M	Gram L
PUNJAB												
RICE	99.4	101.6	101.6	95.0	95.0	95.0	1.4	0.3	0.3	49.4	49.4	49.4
SUGACANE	98.8	107.5	100.6	95.0	95.0	95.0	0.8	0.7	0.7	49.4	49.4	49.4
COTTON	111.2	111.7	114.6	95.0	95.0	95.0	0.8	0.7	0.7	49.4	49.4	49.4
BARANI	95.0	95.0	95.0	95.0	95.0	95.0	0.8	0.7	0.7	49.4	49.4	49.4
SIND												
RICE	99.4	101.6	101.6	95.0	95.0	95.0	1.4	0.3	0.3	49.4	49.4	49.4
COTTON	111.2	111.7	114.6	95.0	95.0	95.0	0.8	0.7	0.7	49.4	49.4	49.4
NWFP												
IRRIGATED	89.0	91.4	98.8	95.0	95.0	95.0	0.6	0.7	0.7	49.4	49.4	49.4
UN-IRRIGATED	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	19.8	19.8	19.8
BALUCHISTAN	98.8	98.8	98.8	98.8	98.8	98.8	0.8	0.7	0.7	24.7	24.7	24.7

Continued for Rabi Crops ...

CROP ZONES	Other Pulses (Masoor) S	Other Pulses (Masoor) M	Other Pulses (Masoor) L	Potato S	Potato M	Potato L	Oilseed (Rapseed & Mustard) S	Oilseed (Rapseed & Mustard) M	Oilseed (Rapseed & Mustard) L	Fodder S	Fodder M	Fodder L
PUNJAB												
RICE	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	24.7	24.7	24.7
SUGACANE	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	24.7	24.7	24.7
COTTON	24.7	24.7	24.7	65.3	59.0	49.0	4.9	4.9	4.9	24.7	24.7	24.7
BARANI	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	24.7	24.7	24.7
SIND												
RICE	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	24.7	24.7	24.7
COTTON	24.7	24.7	24.7	65.3	59.0	49.0	4.9	4.9	4.9	24.7	24.7	24.7
NWFP												
IRRIGATED	95.0	95.0	95.0	95.0	95.0	95.0	0.6	0.7	0.7	49.4	49.4	49.4
UN-IRRIGATED	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	19.8	19.8	19.8
BALUCHISTAN	24.7	24.7	24.7	2965.2	2965.2	2965.2	4.9	4.9	4.9	24.7	24.7	24.7

area with the average cost of one spray[5]. Cost of pesticides for Jowar, Bajra, guarseed and gram are assumed to be equal to the pesticide cost of miscellineous crops. It is assumed that all varieties of rice require the same amount of pesticides. Vegetables and fruits are also assumed to be equal in terms of their pesticide costs. Some of the crops usually do not use pesticides wheat, barley and fodder fall in this category. It was further assumed that the same proportion of crop hectares are treated in different farm sizes. This was not, however, the case with vegetables for which the data were taken from the study titled "Survey Report on Potato Production and Utilization in Pakistan". This latter source indicates that the proportion of area treated with pesticides differ by size category.

8.4 Labor

The labor used for sowing, weeding, fertilizer and water applications, and harvesting were aggregated to estimate the total labor requirements for a crop. The labour used for ploughing was captioned under farm-power. The study on mechanisation reports data on family-and hired-labor requirements for various crops. There are other sources which report labor inputs by crop operation. From the later sources, the total labor used could be aggregated. In our estimates, however, separate total was done for family labour and hired labor. In this context the assumptions regarding the share of labour supplied by family at various stages of farming, are summarised in Table 6. These assumptions are valid for all cropping regions in our model.

Data regarding labour input used per hectare in various regions are reported in Table 7.

8.5 Farm Power

Power requirements in Pakistan are met either by bullocks or by tractors. The use of farm power by source of power are well-documented in the study on mechanization by the census organization. Estimates on ploughing labour are generally reported in the form of ploughing done for various crops. These have to be converted into bullock and tractor hours assuming time standards stated in Table 8.

The time standard and proportion of ploughing done by either bullock or tractor stated in Table 9 were used for all the crops in different regions.

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5 For price per spray, see the section on pesticide price.

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Table 6. Family Labour as Percentage of Total Labour Used at Various Stages of Farming Activities in Pakistan, by Farm size, 1987-88.

S.No.	Activities	Percentage of Family Labour Employed by:*		
		Small Farms	Medium Farms	Large Farms
1.	Sowing			
	- Rice	20	10	0
	- Other crops	90	60	40
2.	Fertilizer Application	100	60	40
3.	Weeding	80	50	20
4.	Bund Making	100	75	50
5.	Water Application	100	70	50
6.	Harvesting and Threshing	40	30	10
7.	Winnowing	100	80	60

Source: Assumptions based on various studies.

*The rest of the labour is obviously the hired one.

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Table 7. **LABOR USE (MANDAYS/HECTARE) FOR CROPS IN PAKISTAN, 1987-88**

(a) Kharif Crops

CROP ZONE		Rice (B) S	Rice (B) M	Rice (B) L	Rice (o) S	Rice (o) M	Rice (o) L	Maize S	Maize M	Maize L	Jowar S	Jowar M	Jowar L	Cotton S	Cotton M	Cotton L	Sugarcane S	Sugarcane M	Sugarcane L
PUNJAB																			
RICE	TOTAL	68.6	77.6	67.3	68.9	69.8	40.9	33.6	33.5	33.4	6.3	7.1	6.1	41.0	40.4	34.6	171.3	182.6	181.3
	HIRED	0.8	11.0	13.6	10.9	19.8	7.4	13.6	19.8	27.1	0.0	0.0	0.0	15.3	23.0	27.1	0.0	0.0	14.1
	FAMILY	67.8	66.6	53.7	58.0	50.0	33.5	20.0	13.7	6.3	6.3	7.1	6.1	25.7	17.4	7.5	171.3	182.6	167.2
SUGARCANE	TOTAL	57.6	70.0	64.0	49.4	49.4	49.4	37.5	39.7	27.6	6.3	7.1	6.1	119.4	114.3	113.8	154.2	148.1	150.2
	HIRED	26.4	36.9	33.8	16.8	28.5	38.8	4.9	3.7	2.3	0.0	0.0	0.0	14.8	56.3	74.1	0.0	21.5	36.2
	FAMILY	31.2	33.1	30.2	32.6	20.9	10.6	32.6	36.0	25.3	6.3	7.1	6.1	104.6	58.1	39.7	154.2	126.6	113.9
COTTON	TOTAL	54.6	56.2	57.6	49.4	49.4	49.4	32.0	9.9	20.5	6.3	7.1	6.1	112.7	99.8	90.5	152.9	142.3	191.1
	HIRED	24.5	37.3	37.3	16.8	24.7	38.8	0.0	6.5	0.0	0.0	0.0	0.0	69.2	78.6	62.9	19.3	16.8	123.6
	FAMILY	30.1	19.0	20.3	32.6	24.7	10.6	32.0	3.4	20.5	6.3	7.1	6.1	43.5	21.2	27.6	133.6	125.5	67.6
BARANI	TOTAL	54.6	56.2	57.6	49.4	49.4	49.4	4.6	3.1	3.1	6.3	7.1	6.1	119.4	114.3	113.8	171.3	182.6	181.3
	HIRED	24.5	37.3	37.3	16.8	24.7	38.8	2.0	2.5	2.8	0.0	0.0	0.0	14.8	56.3	74.1	0.0	0.0	14.1
	FAMILY	30.1	19.0	20.3	32.6	24.7	10.6	2.6	0.6	0.2	6.3	7.1	6.1	104.6	58.1	39.7	171.3	182.6	167.2
SIND																			
RICE	TOTAL	---	---	---	551.2	558.4	327.6	268.8	267.9	266.9	50.6	56.9	48.7	328.1	323.2	276.8	1370.5	1461.0	1450.4
	HIRED	---	---	---	87.0	158.1	59.3	108.7	158.1	216.5	0.0	0.0	0.0	122.6	184.2	216.5	0.0	0.0	112.9
	FAMILY	---	---	---	464.3	400.3	268.3	160.1	109.7	50.4	50.6	56.9	48.7	205.6	139.0	60.3	1370.5	1461.0	1337.5
COTTON	TOTAL	---	---	---	395.4	395.4	395.4	255.7	78.9	163.9	50.6	56.9	48.7	901.4	798.3	723.9	1223.1	1138.6	1529.1
	HIRED	---	---	---	134.4	197.7	310.4	0.0	51.9	0.0	0.0	0.0	0.0	553.5	628.7	502.9	154.4	134.4	988.4
	FAMILY	---	---	---	260.9	197.7	85.0	255.7	27.1	163.9	50.6	56.9	48.7	347.9	169.6	221.0	1068.7	1004.2	540.7
NWFP																			
IRRIGATED	TOTAL	548.5	621.1	538.5	551.2	558.4	327.6	322.2	321.2	320.2	50.6	56.9	43.7	328.1	323.2	276.8	567.3	565.4	563.4
	HIRED	6.2	88.3	109.1	87.0	158.1	59.3	116.6	179.5	247.5	0.0	0.0	0.0	122.6	184.2	216.5	197.7	316.3	438.8
	FAMILY	542.4	532.7	429.4	464.3	400.3	268.3	205.6	141.7	72.7	50.6	56.9	48.7	205.6	139.0	60.3	369.7	249.1	124.5
UN-IRRIGATED	TOTAL	437.2	449.7	460.8	395.4	395.4	395.4	40.5	26.7	24.7	50.6	56.9	48.7	328.1	323.2	276.8	567.3	565.4	563.4
	HIRED	196.2	298.0	298.4	134.4	197.7	310.4	15.8	19.8	22.7	0.0	0.0	0.0	122.6	184.2	216.5	197.7	316.3	438.8
	FAMILY	241.0	151.7	162.4	260.9	197.7	85.0	24.7	6.9	2.0	50.6	56.9	48.7	205.6	139.0	60.3	369.7	249.1	124.5
BALUCHISTAN	TOTAL	229.8	212.0	210.0	270.8	268.8	266.9	72.6	72.6	72.6	50.6	56.9	48.7	955.0	914.7	910.4	1370.5	1461.0	1450.4
	HIRED	79.1	118.6	164.6	100.8	153.2	212.5	44.6	53.3	65.9	0.0	0.0	0.0	118.6	450.1	593.0	0.0	0.0	112.9
	FAMILY	150.7	93.4	45.5	170.0	115.6	54.4	28.1	19.3	6.8	50.6	56.9	48.7	836.4	464.6	317.4	1370.5	1461.0	1337.5

Table 7. Continued for Kharif Crops

CROP ZONE		Oilseed S	Oilseed M	Oilseed L	Pulses S	Pulses M	Pulses L	Vegetables S	Vegetables M	Vegetables L	Guarseed S	Guarseed M	Guarseed L	Fodder S	Fodder M	Fodder L
PUNJAB																
RICE	TOTAL	132.1	132.1	132.1	29.1	29.1	29.1	53.1	53.1	53.1	9.9	8.8	8.6	231.8	231.8	231.8
	HIRED	33.0	66.0	112.2	9.4	15.0	21.8	24.2	34.0	44.6	2.0	4.4	6.5	22.7	47.8	94.1
	FAMILY	99.0	66.0	19.8	19.7	14.1	7.3	28.9	19.2	8.5	7.9	4.4	2.2	209.0	184.0	137.7
SUGARCANE	TOTAL	132.1	132.1	132.1	29.1	29.1	29.1	53.1	53.1	53.1	9.9	8.8	8.6	231.8	231.8	231.8
	HIRED	33.0	66.0	112.2	9.4	15.0	21.8	24.2	34.0	44.6	2.0	4.4	6.5	22.7	47.8	94.1
	FAMILY	99.0	66.0	19.8	19.7	14.1	7.3	28.9	19.2	8.5	7.9	4.4	2.2	209.0	184.0	137.7
COTTON	TOTAL	132.1	132.1	132.1	29.1	29.1	29.1	53.1	53.1	53.1	9.9	8.8	8.6	231.8	231.8	231.8
	HIRED	33.0	66.0	112.2	9.4	15.0	21.8	24.2	34.0	44.6	2.0	4.4	6.5	22.7	47.8	94.1
	FAMILY	99.0	66.0	19.8	19.7	14.1	7.3	28.9	19.2	8.5	7.9	4.4	2.2	209.0	184.0	137.7
BARANI	TOTAL	132.1	132.1	132.1	29.1	29.1	29.1	53.1	53.1	53.1	23.1	23.1	23.1	231.8	231.8	231.8
	HIRED	33.0	66.0	112.2	9.4	15.0	21.8	24.2	34.0	44.6	0.0	0.0	0.0	22.7	47.8	94.1
	FAMILY	99.0	66.0	19.8	19.7	14.1	7.3	28.9	19.2	8.5	23.1	23.1	23.1	209.0	184.0	137.7
SIND																
RICE	TOTAL	1056.4	1056.4	1056.4	232.7	232.7	232.7	425.0	425.0	425.0	79.1	70.2	69.2	1854.2	1854.2	1854.2
	HIRED	264.1	528.2	898.0	75.1	119.7	174.1	193.7	271.8	356.8	15.8	35.1	51.9	182.0	382.2	752.6
	FAMILY	792.3	528.2	158.5	157.6	113.0	58.6	231.3	153.2	68.2	63.3	35.1	17.3	1672.3	1472.0	1101.7
	TOTAL	1056.4	1056.4	1056.4	232.7	232.7	232.7	425.0	425.0	425.0	79.1	70.2	69.2	1854.2	1854.2	1854.2

Table 7. Continued for Kharif Crops

CROP ZONE		Oilseed S	Oilseed M	Oilseed L	Pulses S	Pulses M	Pulses L	Vegetables S	Vegetables M	Vegetables L	Guarseed S	Guarseed M	Guarseed L	Fodder S	Fodder M	Fodder L
COTTON	HIRED	264.1	528.2	898.0	75.1	119.7	174.1	193.7	271.8	356.8	15.8	35.1	51.9	182.0	382.2	752.6
	FAMILY	792.3	528.2	158.5	157.6	113.0	58.6	231.3	153.2	68.2	63.3	35.1	17.3	1672.3	1472.0	1101.7
NWFP																
IRRIGATED	TOTAL	1056.4	1056.4	1056.4	232.7	232.7	232.7	425.0	425.0	425.0	79.1	70.2	69.2	155.2	149.2	148.3
	HIRED	264.1	528.2	898.0	75.1	119.7	174.1	193.7	271.8	356.8	15.8	35.1	51.9	13.8	38.1	67.2
	FAMILY	792.3	528.2	158.5	157.6	113.0	58.6	231.3	153.2	68.2	63.3	35.1	17.3	141.3	111.2	81.0
UN-IRRIGATED	TOTAL	1056.4	1056.4	1056.4	232.7	232.7	232.7	425.0	425.0	425.0	184.4	184.4	184.4	155.2	149.2	148.3
	HIRED	264.1	528.2	898.0	75.1	119.7	174.1	193.7	271.8	356.8	0.0	0.0	0.0	13.8	38.1	67.2
	FAMILY	792.3	528.2	158.5	157.6	113.0	58.6	231.3	153.2	68.2	184.4	184.4	184.4	141.3	111.2	81.0
BALUCHISTAN	TOTAL	1056.4	1056.4	1056.4	232.7	232.7	232.7	425.0	425.0	425.0	84.0	184.4	184.4	1854.2	1854.2	1854.2
	HIRED	264.1	528.2	898.0	75.1	119.7	174.1	193.7	271.8	356.8	35.6	0.0	0.0	182.0	382.2	752.6
	FAMILY	792.3	528.2	158.5	157.6	113.0	58.6	231.3	153.2	68.2	48.4	184.4	184.4	1672.3	1472.0	1101.7

Table 7. continue (b) Rabi Crops

CROP ZONE		Wheat S	Wheat M	Wheat L	Barley S	Barley M	Barley L	Tobacco S	Tobacco M	Tobacco L	Gram S	Gram M	Gram L
PUNJAB													
RICE	TOTAL	25.7	22.1	15.9	13.6	13.6	13.6	112.7	56.8	88.6	9.9	8.8	8.6
	HIRED	0.5	5.6	5.0	8.9	10.3	12.6	2.5	0.0	0.0	2.0	4.4	6.5
	FAMILY	25.2	16.4	10.9	4.7	3.3	1.0	110.2	56.8	88.6	7.9	4.4	2.2
SUGARCANE	TOTAL	29.1	25.9	23.3	13.6	13.6	13.6	52.8	50.7	41.4	9.9	8.8	8.6
	HIRED	5.8	9.3	6.4	8.9	10.3	12.6	20.8	26.4	20.1	2.0	4.4	6.5
	FAMILY	23.4	16.6	16.9	4.7	3.3	1.0	32.0	24.2	21.3	7.9	4.4	2.2
COTTON	TOTAL	27.9	21.7	21.5	13.6	13.6	13.6	52.8	50.7	41.4	9.9	8.8	8.6
	HIRED	10.8	7.6	9.7	8.9	10.3	12.6	20.8	26.4	20.1	2.0	4.4	6.5
	FAMILY	17.2	14.1	11.8	4.7	3.3	1.0	32.0	24.2	21.3	7.9	4.4	2.2
BARANI	TOTAL	18.1	18.1	18.1	13.6	13.6	13.6	52.8	50.7	41.4	23.1	23.1	23.1
	HIRED	11.9	13.7	16.8	8.9	10.3	12.6	20.8	26.4	20.1	0.0	0.0	0.0
	FAMILY	6.3	4.5	1.3	4.7	3.3	1.0	32.0	24.2	21.3	23.1	23.1	23.1
SIND													
RICE	TOTAL	205.6	176.5	127.2	108.8	108.8	108.8	901.3	454.7	708.6	79.1	70.2	69.2
	HIRED	4.0	45.0	40.0	71.2	82.1	100.9	19.8	0.0	0.0	15.8	35.1	51.9
	FAMILY	201.6	131.5	87.3	37.6	26.7	7.9	881.5	454.7	708.6	63.3	35.1	17.3
COTTON	TOTAL	223.5	173.6	172.2	108.8	108.8	108.8	422.2	405.2	331.3	79.1	70.2	69.2
	HIRED	86.2	60.5	77.9	71.2	82.1	100.9	166.2	211.5	160.7	15.8	35.1	51.9
	FAMILY	137.2	113.0	94.2	37.6	26.7	7.9	256.0	193.7	170.6	63.3	35.1	17.3
NWFP													
IRRIGATED	TOTAL	89.0	99.8	118.6	108.8	108.8	108.8	573.3	537.7	533.7	79.1	70.2	69.2
	HIRED	11.9	44.5	83.0	71.2	82.1	100.9	174.0	307.4	431.9	15.8	35.1	51.9
	FAMILY	77.1	55.4	35.6	37.6	26.7	7.9	399.3	230.3	101.8	63.3	35.1	17.3
	TOTAL	145.0	145.0	145.0	108.8	108.8	108.8	573.3	537.7	533.7	184.4	184.4	184.4

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Table 7. Continued for Rabi Crops

CROP ZONE		Pulses S	Pulses M	Pulses L	Potato S	Potato M	Potato L	Oilseed S	Oilseed M	Oilseed L	Fodder S	Fodder M	Fodder L
UN-IRRIGATED	HIRED	94.9	109.4	134.5	71.2	82.1	100.9	174.0	307.4	431.9	0.0	0.0	0.0
	FAMILY	50.1	35.6	10.5	37.6	26.7	7.9	399.3	230.3	101.8	184.4	184.4	184.4
	TOTAL	300.5	291.6	290.6	225.4	218.7	217.9	422.2	405.2	331.3	84.0	184.4	184.4
BALUCHISTAN	HIRED	106.0	169.6	243.1	79.5	127.2	182.4	166.2	211.5	160.7	35.6	0.0	0.0
	FAMILY	194.5	122.0	47.4	145.9	91.5	35.6	256.0	193.7	170.6	48.4	184.4	184.4
PUNJAB													
	TOTAL	4.9	4.9	4.9	90.2	90.2	90.2	17.3	15.1	14.8	231.8	231.8	231.8
RICE	HIRED	1.0	2.5	4.0	33.6	55.2	75.2	3.5	7.5	11.0	22.7	47.8	94.1
	FAMILY	4.0	2.5	1.0	56.6	35.0	14.9	13.8	7.5	3.8	209.0	184.0	137.7
	TOTAL	4.9	4.9	4.9	90.2	90.2	90.2	17.3	15.1	14.8	231.8	231.8	231.8
SUGARCANE	HIRED	1.0	2.5	4.0	33.6	55.2	75.2	3.5	7.5	11.0	22.7	47.8	94.1
	FAMILY	4.0	2.5	1.0	56.6	35.0	14.9	13.8	7.5	3.8	209.0	184.0	137.7
	TOTAL	4.9	4.9	4.9	47.5	48.9	51.6	17.3	15.1	14.8	231.8	231.8	231.8
COTTON	HIRED	1.0	2.5	4.0	19.1	31.7	32.9	3.5	7.5	11.0	22.7	47.8	94.1
	FAMILY	4.0	2.5	1.0	28.4	17.2	18.7	13.8	7.5	3.8	209.0	184.0	137.7
	TOTAL	4.9	4.9	4.9	90.2	90.2	90.2	17.3	15.1	14.8	231.8	231.8	231.8
BARANI	HIRED	1.0	2.5	4.0	33.6	55.2	75.2	3.5	7.5	11.0	22.7	47.8	94.1
	FAMILY	4.0	2.5	1.0	56.6	35.0	14.9	13.8	7.5	3.8	209.0	184.0	137.7
SIND													
	TOTAL	39.5	39.5	39.5	721.5	721.5	721.5	138.4	120.6	118.6	1854.2	1854.2	1854.2
RICE	HIRED	7.9	19.8	31.6	268.8	441.8	601.9	27.7	60.3	88.0	182.0	382.2	752.6
	FAMILY	31.6	19.8	7.9	452.7	279.7	119.6	110.7	60.3	30.6	1672.3	1472.0	1101.7
	TOTAL	39.5	39.5	39.5	380.1	391.0	412.8	138.4	120.6	118.6	1854.2	1854.2	1854.2
COTTON	HIRED	7.9	19.8	31.6	152.8	253.6	263.3	27.7	60.3	88.0	182.0	382.2	752.6
	FAMILY	31.6	19.8	7.9	227.3	137.4	149.4	110.7	60.3	30.6	1672.3	1472.0	1101.7
NWFP													
	TOTAL	39.5	39.5	39.5	721.5	721.5	721.5	138.4	120.6	118.6	60.2	51.3	50.4
IRRIGATED	HIRED	7.9	19.8	31.6	268.8	441.8	601.9	27.7	60.3	88.0	4.0	18.2	27.7
	FAMILY	31.6	19.8	7.9	452.7	279.7	119.6	110.7	60.3	30.6	56.3	33.2	22.6
	TOTAL	39.5	39.5	39.5	721.5	721.5	721.5	138.4	120.6	118.6	60.2	51.3	50.4
UN-IRRIGATED	HIRED	7.9	19.8	31.6	268.8	441.8	601.9	27.7	60.3	88.0	4.0	18.2	27.7
	FAMILY	31.6	19.8	7.9	452.7	279.7	119.6	110.7	60.3	30.6	56.3	33.2	22.6
	TOTAL	39.5	39.5	39.5	721.5	721.5	721.5	138.4	120.6	118.6	1854.2	1854.2	1854.2
BALUCHISTAN	HIRED	7.9	19.8	31.6	268.8	441.8	601.9	27.7	60.3	88.0	182.0	382.2	752.6
	FAMILY	31.6	19.8	7.9	452.7	279.7	119.6	110.7	60.3	30.6	1672.3	1472.0	1101.7

TABLE 8. Estimated Time Required for Selected Farm Activities in Pakistan, 1987-88

S.No.	Activity	Time Required	
		With Bullock	With Tractor
1.	Ploughing (Hours/Hactare)	9.93	1.59
2.	Planking (Hours/Hactare)	1.63	.79
3.	Transporting one cart (Hours/Cart)	4.00	1.06

Source: **Pakistan Census of Agricultural Machinery,** 1984, Agricultural Census Organization, Government of Pakistan.

TABLE 9. (Ploughing with Bullock in Pakistan, By Farm Size, 1987-88)

S. No.	Activity	Small Farm	Medium Farm	Large Farm
1.	Ploughing with Bullock (%)	40	20	0
2.	Proportion of Farm owning Tractors	18	50	100

Source: **Pakistan Census of Agricultural Machinery, 1984,** Agricultural Census Organization, Government of Pakistan.

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Bullock time, tractor time (hired and owned) and thresher time usage is presented in Table 10. In estimating this table, it was assumed that bullocks are provided from the family owned sources of the farmer, thus the bullock time spent on farms were not valued. Cost of raising bullocks, however, have been included in the livestock sub-sector in our model.

Tractors and machinery (primarily threshers and combines) may or may not be owned by the farmer, but the charge will reflect both the variable costs (fuel, oil, and repairs) as well as the fixed costs (depreciation, interest charges). Because a larger proportion of the small farmers would rent tractors and other machinery (and the driver/operator) the costs to them is therefore assumed to be 10% higher than the medium farms; for the large farms it is taken to be 10% lower.

8.6 Water Use

The water from canals are not measured in physical quantities. The water rate of each crop in different areas are treated as cost of applying canal water. Water rates for different areas by crop enterprize are reported in Table 11.

Per hectare supplimentary water requirements from tubewell (owned or otherwise) are reported in Table 12. In some cases, the data on supplimentary water are available in the form of number of irrigation, rather than by hours of water applied. The number of supplimetary irrigations from tubewell were therefore converted into hours by assuming that eight hours will be required for one irrigation per hectare.

8.7 Payment to Artisans

Payments to artisans reflects the cost of maintinance and depreciation of the equipmnents on the farm because the artisan not only repairs but also prepares the new farm equipments. The

interest cost of the equipments could not be counted because of non-availability of data on farm equipment inventory.

8.8 Farm Manure

Farm manure is used on the farm along with fertilizer to improve soil fertility. Farm manure is treated as fixed input and is not valued in the objective function. The total farm manure production in Pakistan reported in Agricultural Statistics of Pakistan was proportionately allocated to different regions based on the number of livestock animal in a region.

Table 10. **POWER USE (HRS/HECTARE) FOR VARIOUS CROPS IN PAKISTAN BY ZONE AND SIZE CATEGORY, 1987-88**

(a) Kharif Crops

CROP ZONE COST ITEMS	Rice (B)			Rice (o)			Maize			Jowar			Cotton			Sugarcane		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
PUNJAB																		
RICE ZONE																		
BULLOCK LABOR	66.7	49.1	0.0	51.6	4.9	0.0	37.0	28.4	19.8	116.0	95.0	32.0	27.4	13.7	0.0	65.5	17.3	74.1
TOTAL TRACTOR	0.0	4.9	12.4	0.0	13.6	12.2	4.8	6.3	7.9	0.4	1.5	2.7	6.7	9.5	12.3	0.0	14.8	23.7
OWNED TRACTOR	0.0	2.5	12.4	0.0	6.8	12.2	0.0	3.2	7.9	0.1	1.4	2.6	0.0	4.7	12.3	0.0	7.4	23.7
HIRED TRACTOR	0.0	2.5	0.0	0.0	6.8	0.0	4.8	3.2	0.0	0.4	0.1	0.1	6.7	4.7	0.0	0.0	7.4	0.0
THRESHER	0.0	0.0	2.5	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUGACANE ZONE																		
BULLOCK LABOR	188.8	161.7	96.9	35.1	17.5	0.0	66.0	38.7	0.0	116.0	95.0	32.0	56.8	36.9	0.0	77.2	51.5	0.0
TOTAL TRACTOR	0.6	3.0	7.1	10.0	13.3	16.6	0.0	8.1	15.4	0.4	1.5	2.7	0.0	11.1	27.2	0.0	8.6	22.2
OWNED TRACTOR	0.0	1.9	6.9	0.0	6.7	16.6	0.0	4.0	15.4	0.1	1.4	2.6	0.0	5.6	27.2	0.0	4.3	22.2
HIRED TRACTOR	0.6	1.1	0.2	10.0	6.7	0.0	0.0	4.0	0.0	0.4	0.1	0.1	0.0	5.6	0.0	0.0	4.3	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON ZONE																		
BULLOCK LABOR	143.4	110.6	46.3	35.1	4.9	0.0	49.4	8.5	7.4	116.0	95.0	32.0	77.2	32.6	0.0	7.4	8.6	13.6
TOTAL TRACTOR	0.6	5.7	5.2	10.0	8.5	16.6	0.0	4.9	0.0	0.4	1.5	2.7	38.4	9.7	18.9	58.1	29.4	0.0
OWNED TRACTOR	0.0	2.8	5.2	0.0	4.3	16.6	0.0	2.5	0.0	0.1	1.4	2.6	0.0	4.8	18.9	0.0	14.7	0.0
HIRED TRACTOR	0.6	2.8	0.0	10.0	4.3	0.0	0.0	2.5	0.0	0.4	0.1	0.1	38.4	4.8	0.0	58.1	14.7	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARANI ZONE																		
BULLOCK LABOR	143.4	110.6	46.3	35.1	4.9	0.0	19.1	12.3	9.9	116.0	95.0	32.0	56.8	36.9	0.0	65.5	17.3	74.1
TOTAL TRACTOR	0.6	5.7	5.2	10.0	8.5	16.6	2.9	1.5	1.9	0.4	1.5	2.7	0.0	11.1	27.2	0.0	14.8	23.7
OWNED TRACTOR	0.0	2.8	5.2	0.0	4.3	16.6	0.0	0.8	1.9	0.1	1.4	2.6	0.0	5.6	27.2	0.0	7.4	23.7
HIRED TRACTOR	0.6	2.8	0.0	10.0	4.3	0.0	2.9	0.8	0.0	0.4	0.1	0.1	0.0	5.6	0.0	0.0	7.4	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SIND																		
RICE ZONE																		
BULLOCK LABOR	---	---	---	51.64	4.94	0.00	36.97	28.37	19.77	116.01	95.01	31.97	27.42	13.71	0.00	65.48	17.30	74.13
TOTAL TRACTOR	---	---	---	0.00	13.59	12.18	4.75	6.34	7.92	0.44	1.53	2.69	6.65	9.49	12.32	0.00	14.83	23.70
OWNED TRACTOR	---	---	---	0.00	6.80	12.18	0.86	3.17	7.92	0.07	1.41	2.62	1.20	4.74	12.32	0.00	7.41	23.70
HIRED TRACTOR	---	---	---	0.00	6.80	0.00	3.90	3.17	0.00	0.37	0.12	0.07	5.45	4.74	0.00	0.00	7.41	0.00
THRESHER	---	---	---	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTON ZONE																		
BULLOCK LABOR	---	---	---	35.05	4.94	0.00	49.42	8.52	7.41	116.01	95.01	31.97	77.22	32.57	0.00	7.41	8.65	13.59
TOTAL TRACTOR	---	---	---	9.98	8.52	16.63	0.00	4.94	0.00	0.44	1.53	2.69	38.42	9.66	18.88	58.07	29.43	0.00
OWNED TRACTOR	---	---	---	0.00	4.26	16.63	0.00	2.47	0.00	0.07	1.41	2.62	6.92	4.83	18.88	10.45	14.71	0.00
HIRED TRACTOR	---	---	---	9.98	4.26	0.00	0.00	2.47	0.00	0.37	0.12	0.07	31.51	4.83	0.00	47.62	14.71	0.00
THRESHER	---	---	---	0.00	0.00	0.00	0.00	7.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10. Continued for (a) Kharif Crops

CROP ZONE COST ITEMS	Rice (B)			Rice (o)			Maize			Jowar			Cotton			Sugarcane		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
NWFP																		
IRRIGATED ZONE																		
BULLOCK LABOR	66.67	49.10	0.00	51.64	4.94	0.00	7.10	4.78	2.47	116.01	95.01	31.97	27.42	13.71	0.00	47.52	33.65	19.77
TOTAL TRACTOR	0.00	4.94	12.40	0.00	13.59	12.18	1.43	1.90	2.38	0.44	1.53	2.69	6.65	9.49	12.32	8.55	11.40	14.25
OWNED TRACTOR	0.00	2.47	12.40	0.00	6.80	12.18	0.26	0.95	2.38	0.07	1.41	2.62	1.20	4.74	12.32	1.54	5.70	14.25
HIRED TRACTOR	0.00	2.47	0.00	0.00	6.80	0.00	1.17	0.95	0.00	0.37	0.12	0.07	5.45	4.74	0.00	7.01	5.70	0.00
THRESHER	0.00	0.00	2.50	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BULLOCK LABOR	143.42	110.55	46.26	35.05	4.94	0.00	19.14	14.51	9.88	116.01	95.01	31.97	27.42	13.71	0.00	47.52	33.65	19.77
TOTAL TRACTOR	0.59	5.68	5.21	9.98	8.52	16.63	2.85	3.80	4.75	0.44	1.53	2.69	6.65	9.49	12.32	8.55	11.40	14.25
OWNED TRACTOR	0.11	2.84	5.21	1.80	4.26	16.63	0.51	1.90	4.75	0.07	1.41	2.62	1.20	4.74	12.32	1.54	5.70	14.25
HIRED TRACTOR	0.49	2.84	0.00	8.18	4.26	0.00	2.34	1.90	0.00	0.37	0.12	0.07	5.45	4.74	0.00	7.01	5.70	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALUCHISTAN																		
BULLOCK LABOR	25.92	110.55	46.26	35.05	4.94	0.00	19.14	12.30	9.88	116.01	95.01	31.97	56.83	36.87	0.00	65.48	17.30	74.13
TOTAL TRACTOR	6.89	5.68	5.21	9.98	8.52	16.63	2.85	1.54	1.93	0.44	1.53	2.69	0.00	11.12	27.18	0.00	14.83	23.70
OWNED TRACTOR	1.24	2.84	5.21	0.00	4.26	16.63	0.51	0.77	1.93	0.07	1.41	2.62	0.00	5.56	27.18	0.00	7.41	23.70
HIRED TRACTOR	5.65	2.84	0.00	9.98	4.26	0.00	2.34	0.77	0.00	0.37	0.12	0.07	0.00	5.56	0.00	0.00	7.41	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
RICE ZONE																		
BULLOCK LABOR	5.4	2.7	0.0	48.1	43.8	39.5	26.5	13.2	0.0	58.6	49.7	40.8	5.9	3.0	0.0			
TOTAL TRACTOR	1.5	2.1	2.6	2.3	3.1	3.9	7.6	10.1	12.7	5.7	7.6	9.5	2.4	3.2	4.0			
OWNED TRACTOR	0.0	1.0	2.6	0.0	1.6	3.9	0.0	5.1	12.7	0.0	3.8	9.5	0.0	1.6	4.0			
HIRED TRACTOR	1.5	1.0	0.0	2.3	1.6	0.0	7.6	5.1	0.0	5.7	3.8	0.0	2.4	1.6	0.0			
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUGARCANE ZONE																		
BULLOCK LABOR	5.4	2.7	0.0	48.1	43.8	39.5	26.5	13.2	0.0	58.6	49.7	40.8	5.9	3.0	0.0			
TOTAL TRACTOR	1.5	2.1	2.6	2.3	3.1	3.9	7.6	10.1	12.7	5.7	7.6	9.5	2.4	3.2	4.0			
OWNED TRACTOR	0.0	1.0	2.6	0.0	1.6	3.9	0.0	5.1	12.7	0.0	3.8	9.5	0.0	1.6	4.0			
HIRED TRACTOR	1.5	1.0	0.0	2.3	1.6	0.0	7.6	5.1	0.0	5.7	3.8	0.0	2.4	1.6	0.0			
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

Table 10. Continued for Kharif Crops

CROP ZONE COST ITEMS	Oilseed S	Oilseed M	Oilseed L	Pulses S	Pulses M	Pulses L	Vegetables S	Vegetables M	Vegetables L	Guarseed S	Guarseed M	Guarseed L	Fodder S	Fodder M	Fodder L
COTTON															
BULLOCK LABOR	5.4	2.7	0.0	48.1	43.8	39.5	26.5	13.2	0.0	58.6	49.7	40.8	5.9	3.0	0.0
TOTAL TRACTOR	1.5	2.1	2.6	2.3	3.1	3.9	7.6	10.1	12.7	5.7	7.6	9.5	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.0	2.6	0.0	1.6	3.9	0.0	5.1	12.7	0.0	3.8	9.5	0.0	1.6	4.0
HIRED TRACTOR	1.5	1.0	0.0	2.3	1.6	0.0	7.6	5.1	0.0	5.7	3.8	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARANI															
BULLOCK LABOR	5.4	2.7	0.0	48.1	43.8	39.5	26.5	13.2	0.0	177.9	177.9	177.9	5.9	3.0	0.0
TOTAL TRACTOR	1.5	2.1	2.6	2.3	3.1	3.9	7.6	10.1	12.7	0.0	0.0	0.0	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.0	2.6	0.0	1.6	3.9	0.0	5.1	12.7	0.0	0.0	0.0	0.0	1.6	4.0
HIRED TRACTOR	1.5	1.0	0.0	2.3	1.6	0.0	7.6	5.1	0.0	0.0	0.0	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SIND															
RICE ZONE															
BULLOCK LABOR	5.35	2.68	0.00	48.10	43.82	39.54	26.45	13.23	0.00	58.56	49.67	40.77	5.93	2.96	0.00
TOTAL TRACTOR	1.54	2.05	2.56	2.33	3.11	3.89	7.60	10.14	12.67	5.68	7.58	9.47	2.37	3.16	3.96
OWNED TRACTOR	0.00	1.03	2.56	0.00	1.56	3.89	1.37	5.07	12.67	1.02	3.79	9.47	0.43	1.58	3.96
HIRED TRACTOR	1.54	1.03	0.00	2.33	1.56	0.00	6.23	5.07	0.00	4.66	3.79	0.00	1.95	1.58	0.00
THRESHERS	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BULLOCK LABOR	5.35	2.68	0.00	48.10	43.82	39.54	26.45	13.23	0.00	58.56	49.67	40.77	5.93	2.96	0.00
TOTAL TRACTOR	1.54	2.05	2.56	2.33	3.11	3.89	7.60	10.14	12.67	5.68	7.58	9.47	2.37	3.16	3.96
OWNED TRACTOR	0.00	1.03	2.56	0.00	1.56	3.89	1.37	5.07	12.67	1.02	3.79	9.47	0.43	1.58	3.96
HIRED TRACTOR	1.54	1.03	0.00	2.33	1.56	0.00	6.23	5.07	0.00	4.66	3.79	0.00	1.95	1.58	0.00
THRSHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NWFP															
IRRIGATED															
BULLOCK LABOR	5.35	2.68	0.00	48.10	43.82	39.54	26.45	13.23	0.00	58.56	49.67	40.77	8.60	4.30	0.00
TOTAL TRACTOR	1.54	2.05	2.56	2.33	3.11	3.89	7.60	10.14	12.67	5.68	7.58	9.47	2.38	3.17	3.96
OWNED TRACTOR	0.28	1.03	2.56	0.42	1.56	3.89	1.37	5.07	12.67	1.02	3.79	9.47	0.00	1.58	3.96
HIRED TRACTOR	1.26	1.03	0.00	1.91	1.56	0.00	6.23	5.07	0.00	4.66	3.79	0.00	2.38	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UN-IRRIGATED															
BULLOCK LABOR	5.35	2.68	0.00	48.10	43.82	39.54	26.45	13.23	0.00	177.91	177.91	177.91	8.60	4.30	0.00
TOTAL TRACTOR	1.54	2.05	2.56	2.33	3.11	3.89	7.60	10.14	12.67	0.00	0.00	0.00	2.38	3.17	3.96
OWNED TRACTOR	0.28	1.03	2.56	0.42	1.56	3.89	1.37	5.07	12.67	0.00	0.00	0.00	0.00	1.58	3.96
HIRED TRACTOR	1.26	1.03	0.00	1.91	1.56	0.00	6.23	5.07	0.00	0.00	0.00	0.00	2.38	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10. Continued for Kharif Crops

CROP ZONE COST ITEMS	Oilseed S	Oilseed M	Oilseed L	Pulses S	Pulses M	Pulses L	Vegetables S	Vegetables M	Vegetables L	Guarseed S	Guarseed M	Guarseed L	Fodder S	Fodder M	Fodder L
BALUCHISTAN															
BULLOCK LABOR	5.35	2.68	0.00	48.10	43.82	39.54	26.45	13.23	0.00	48.14	43.84	39.54	5.93	2.96	0.00
TOTAL TRACTOR	1.54	2.05	2.56	2.33	3.11	3.89	7.60	10.14	12.67	2.38	3.17	3.96	2.37	3.16	3.96
OWNED TRACTOR	0.00	1.03	2.56	0.42	1.56	3.89	0.00	5.07	12.67	0.00	1.58	3.96	0.00	1.58	3.96
HIRED TRACTOR	1.54	1.03	0.00	1.91	1.56	0.00	7.60	5.07	0.00	2.38	1.58	0.00	2.37	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUNJAB															
RICE ZONE															
BULLOCK LABOR	60.5	33.8	0.0	149.8	149.8	149.8	110.0	61.8	0.0	58.6	49.7	40.8			
TOTAL TRACTOR	0.0	6.3	10.9	3.1	4.2	5.2	0.0	0.0	11.1	5.7	7.6	9.5			
OWNED TRACTOR	0.0	3.2	10.9	0.0	2.1	5.2	0.0	0.0	11.1	0.0	3.8	9.5			
HIRED TRACTOR	0.0	3.2	0.0	3.1	2.1	0.0	0.0	0.0	0.0	5.7	3.8	0.0			
OTHERS	5.6	4.5	3.4	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SUGARCANE ZONE															
BULLOCK LABOR	59.6	42.0	0.0	149.8	149.8	149.8	29.8	13.8	0.0	58.6	49.7	40.8			
TOTAL TRACTOR	0.0	8.4	11.4	3.1	4.2	5.2	27.4	29.8	23.3	5.7	7.6	9.5			
OWNED TRACTOR	0.0	4.2	11.4	0.0	2.1	5.2	22.3	26.2	23.3	0.0	3.8	9.5			
HIRED TRACTOR	0.0	4.2	0.0	3.1	2.1	0.0	5.1	3.7	0.0	5.7	3.8	0.0			
THRESHERT	5.7	6.2	4.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
BULLOCK LABOR	57.1	31.9	0.0	149.8	149.8	149.8	29.8	13.8	0.0	58.6	49.7	40.8			
COTTON ZONE															
TOTAL TRACTOR	6.2	5.8	10.2	3.1	4.2	5.2	27.4	29.8	23.3	5.7	7.6	9.5			
OWNED TRACTOR	0.0	2.9	10.2	0.0	2.1	5.2	22.3	26.2	23.3	0.0	3.8	9.5			
HIRED TRACTOR	6.2	2.9	0.0	3.1	2.1	0.0	5.1	3.7	0.0	5.7	3.8	0.0			
THRESHER	5.5	4.1	4.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
BARANI															
BULLOCK LABOR	149.8	149.8	149.8	149.8	149.8	149.8	29.8	13.8	0.0	177.9	177.9	177.9			
TOTAL TRACTOR	4.2	5.5	6.9	3.1	4.2	5.2	27.4	29.8	23.3	0.0	0.0	0.0			
OWNED TRACTOR	0.0	2.8	6.9	0.0	2.1	5.2	22.3	26.2	23.3	0.0	0.0	0.0			
HIRED TRACTOR	4.2	2.8	0.0	3.1	2.1	0.0	5.1	3.7	0.0	0.0	0.0	0.0			
OTHERS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			

Table 10. to Continue

(b) Rabi Crops

CROP ZONE COST ITEMS	Wheat S	Wheat M	Wheat L	Barley S	Barley M	Barley L	Tobacco S	Tobacco M	Tobacco L	Gram S	Gram M	Gram L
SIND												
RICE ZONE												
BULLOCK LABOR	60.49	33.80	0.00	149.76	149.76	149.76	109.96	61.78	0.00	58.56	49.67	40.77
TOTAL TRACTOR	0.00	6.30	10.95	3.12	4.16	5.20	0.00	0.00	11.12	5.68	7.58	9.47
OWNED TRACTOR	0.00	3.15	10.95	0.00	2.08	5.20	0.00	0.00	11.12	1.02	3.79	9.47
HIRED TRACTOR	0.00	3.15	0.00	3.12	2.08	0.00	0.00	0.00	0.00	4.66	3.79	0.00
THRESHER	5.63	4.52	3.41	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTON ZONE												
BULLOCK LABOR	57.13	31.90	0.00	149.76	149.76	149.76	29.85	13.84	0.00	58.56	49.67	40.77
TOTAL TRACTOR	6.18	5.78	10.16	3.12	4.16	5.20	27.38	29.82	23.33	5.68	7.58	9.47
OWNED TRACTOR	1.11	2.89	10.16	0.00	2.08	5.20	22.29	26.17	23.33	1.02	3.79	9.47
HIRED TRACTOR	5.07	2.89	0.00	3.12	2.08	0.00	5.09	3.66	0.00	4.66	3.79	0.00
THRESHER	5.49	4.13	4.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
NWFP												
IRRIGATED												
BULLOCK LABOR	33.61	16.31	0.00	149.76	149.76	149.76	17.79	8.90	0.00	58.56	49.67	40.77
TOTAL TRACTOR	17.91	16.19	22.44	3.12	4.16	5.20	4.57	6.10	7.62	5.68	7.58	9.47
OWNED TRACTOR	3.22	8.09	22.44	0.56	2.08	5.20	0.82	3.05	7.62	1.02	3.79	9.47
HIRED TRACTOR	14.69	8.09	0.00	2.56	2.08	0.00	3.75	3.05	0.00	4.66	3.79	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UN-IRRIGATED												
BULLOCK LABOR	149.76	149.76	149.76	149.76	149.76	149.76	17.79	8.90	0.00	177.91	177.91	177.91
TOTAL TRACTOR	4.16	5.54	6.93	3.12	4.16	5.20	4.57	6.10	7.62	0.00	0.00	0.00
OWNED TRACTOR	0.75	2.77	6.93	0.56	2.08	5.20	0.82	3.05	7.62	0.00	0.00	0.00
HIRED TRACTOR	3.41	2.77	0.00	2.56	2.08	0.00	3.75	3.05	0.00	0.00	0.00	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALUCHISTAN												
BULLOCK LABOR	0.00	0.00	0.00	0.00	0.00	0.00	29.85	13.84	0.00	48.14	43.84	39.54
TOTAL TRACTOR	7.12	3.17	3.96	5.34	2.38	2.97	27.38	29.82	23.33	2.38	3.17	3.96
OWNED TRACTOR	0.00	1.58	3.96	0.00	1.19	2.97	22.29	26.17	23.33	0.00	1.58	3.96
HIRED TRACTOR	7.12	1.58	0.00	5.34	1.19	0.00	5.09	3.66	0.00	2.38	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10. Continued for Rabi Crops

CROP ZONE COST ITEMS	Pulses S	Pulses M	Pulses L	Potato S	Potato M	Potato L	Oilseed S	Oilseed M	Oilseed L	Fodder S	Fodder M	Fodder L
PUNJAB												
RICE ZONE												
BULLOCK LABOR	13.8	9.4	4.9	29.7	14.8	0.0	21.3	11.9	2.5	5.9	3.0	0.0
TOTAL TRACTOR	2.8	3.8	4.7	10.4	13.8	17.3	6.3	8.4	10.5	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.9	4.7	0.0	6.9	17.3	0.0	4.2	10.5	0.0	1.6	4.0
HIRED TRACTOR	2.8	1.9	0.0	10.4	6.9	0.0	6.3	4.2	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SUGARCANE ZONE												
BULLOCK LABOR	13.8	9.4	4.9	29.7	14.8	0.0	21.3	11.9	2.5	5.9	3.0	0.0
TOTAL TRACTOR	2.8	3.8	4.7	10.4	13.8	17.3	6.3	8.4	10.5	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.9	4.7	0.0	6.9	17.3	0.0	4.2	10.5	0.0	1.6	4.0
HIRED TRACTOR	2.8	1.9	0.0	10.4	6.9	0.0	6.3	4.2	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
COTTON ZONE												
BULLOCK LABOR	13.8	9.4	4.9	3.8	0.0	0.0	21.3	11.9	2.5	5.9	3.0	0.0
TOTAL TRACTOR	2.8	3.8	4.7	12.7	14.3	16.0	6.3	8.4	10.5	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.9	4.7	8.4	14.3	16.0	0.0	4.2	10.5	0.0	1.6	4.0
HIRED TRACTOR	2.8	1.9	0.0	4.4	0.0	0.0	6.3	4.2	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
BARANI												
BULLOCK LABOR	13.8	9.4	4.9	29.7	14.8	0.0	21.3	11.9	2.5	5.9	3.0	0.0
TOTAL TRACTOR	2.8	3.8	4.7	10.4	13.8	17.3	6.3	8.4	10.5	2.4	3.2	4.0
OWNED TRACTOR	0.0	1.9	4.7	0.0	6.9	17.3	0.0	4.2	10.5	0.0	1.6	4.0
HIRED TRACTOR	2.8	1.9	0.0	10.4	6.9	0.0	6.3	4.2	0.0	2.4	1.6	0.0
THRESHER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SIND												
RICE ZONE												
BULLOCK LABOR	13.84	9.39	4.94	29.65	14.83	0.00	21.25	11.86	2.47	5.93	2.96	0.00
TOTAL TRACTOR	2.84	3.79	4.74	10.38	13.84	17.30	6.30	8.40	10.50	2.37	3.16	3.96
OWNED TRACTOR	0.0	1.89	4.74	1.87	6.92	17.30	1.13	4.20	10.50	0.43	1.58	3.96
HIRED TRACTOR	2.84	1.89	0.00	8.51	6.92	0.00	5.17	4.20	0.00	1.95	1.58	0.00
THRESHER	0.0	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTON ZONE												
BULLOCK LABOR	13.84	9.39	4.94	3.76	0.00	0.00	21.25	11.86	2.47	5.93	2.96	0.00
TOTAL TRACTOR	2.84	3.79	4.74	12.73	14.26	16.01	6.30	8.40	10.50	2.37	3.16	3.96
OWNED TRACTOR	0.00	1.89	4.74	8.35	14.26	16.01	1.13	4.20	10.50	0.00	1.58	3.96
HIRED TRACTOR	2.84	1.89	0.00	4.37	0.00	0.00	5.17	4.20	0.00	2.37	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 10. Continued for Rabi Crops

CROP ZONE COST ITEMS	Pulses			Potato			Oilseed			Fodder		
	S	M	L	S	M	L	S	M	L	S	M	L
NWFP												
IRRIGATED ZONE												
BULLOCK LABOR	13.84	9.39	4.94	266.87	133.43	0.00	21.25	11.86	2.47	15.81	7.91	0.00
TOTAL TRACTOR	2.84	3.79	4.74	10.38	13.84	17.30	6.30	8.40	10.50	3.46	4.61	5.77
OWNED TRACTOR	0.51	1.89	4.74	1.87	6.92	17.30	1.13	4.20	10.50	0.62	2.31	5.77
HIRED TRACTOR	2.33	1.89	0.00	8.51	6.92	0.00	5.17	4.20	0.00	2.84	2.31	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UN-IRRIGATED												
BULLOCK LABOR	13.84	9.39	4.94	266.87	133.43	0.00	21.25	11.86	2.47	15.81	7.91	0.00
TOTAL TRACTOR	2.84	3.79	4.74	10.38	13.84	17.30	6.30	8.40	10.50	3.46	4.61	5.77
OWNED TRACTOR	0.51	1.89	4.74	1.87	6.92	17.30	1.13	4.20	10.50	0.62	2.31	5.77
HIRED TRACTOR	2.33	1.89	0.00	8.51	6.92	0.00	5.17	4.20	0.00	2.84	2.31	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALUCHISTAN												
BULLOCK LABOR	13.54	9.24	4.94	29.65	14.83	0.00	21.25	11.86	2.47	5.93	2.96	0.00
TOTAL TRACTOR	2.38	3.17	3.96	10.38	13.84	17.30	6.30	8.40	10.50	2.37	3.16	3.96
OWNED TRACTOR	0.00	1.58	3.96	0.00	6.92	17.30	0.00	4.20	10.50	0.00	1.58	3.96
HIRED TRACTOR	2.38	1.58	0.00	10.38	6.92	0.00	6.30	4.20	0.00	2.37	1.58	0.00
THRESHER	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Table 11. Water Rates (Rs/Hectare) during 1987-88

Crops	Punjab	Sind NWFP	Baluchistan
Kharif Season Crops			
Rice	158.1	158.1	158.1
Maize	47.4	47.4	59.3
Jowar	0.0	0.0	43.5
Cotton	83.0	83.0	83.0
Sugarcane	158.1	158.1	203.6
Oilseed	0.0	0.0	0.0
Pulses	0.0	0.0	0.0
Guarseed	39.5	39.5	55.4
Fodder	49.4	49.4	0.0
Vegetables	0.0	0.0	0.0
Rabi Season Crops			
Wheat	53.4	53.4	59.3
Barley	0.0	0.0	0.0
Tobacco	83.0	83.0	106.7
Gram	39.5	39.5	55.4
Pulses	0.0	0.0	55.4
Vegetables	102.8	102.8	110.2
Oilseed	58.1	58.1	58.1
Fodder	49.4	49.4	43.5

Table 12. **SUPPLIMENTARY WATER USE (HRS/HECTARE) FOR VARIOUS CROPS IN PAKISTAN, 1987-88**

(a) Kharif Crops

CROP ZONE	Rice (B)			Rice (o)			Maize			Jowar			Cotton			Sugarcane		
	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L	S	M	L
PUNJAB																		
RICE	115.3	105.6	92.5	103.8	112.4	107.9	5.9	5.9	5.9	0.0	0.0	0.0	25.9	25.9	25.9	44.5	98.8	115.1
SUGARCANE	6.2	2.7	0.6	19.8	19.8	19.8	49.4	38.3	36.3	0.0	0.0	0.0	51.9	36.5	42.7	89.0	84.9	101.3
COTTON	55.9	36.7	26.1	19.8	19.8	19.8	0.0	37.1	32.1	0.0	0.0	0.0	46.9	44.5	41.9	87.7	74.1	61.8
BARANI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
SIND																		
RICE	---	---	---	103.78	112.43	107.88	5.93	5.93	5.93	0.00	0.00	0.00	25.95	25.95	25.95	44.48	98.84	115.10
COTTON	---	---	---	19.77	19.77	19.77	0.00	37.07	32.12	0.00	0.00	0.00	46.95	44.48	41.86	87.72	74.13	61.78
NWFP																		
IRRIGATED	115.30	105.64	92.46	103.78	112.43	107.88	5.93	5.93	5.93	0.00	0.00	0.00	25.95	25.95	25.95	0.00	0.00	0.00
UN-IRRIGATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALUCHISTAN	49.42	49.42	49.42	39.54	39.54	39.54	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
PUNJAB																		
RICE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	14.8	14.8			
SUGARCANE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	14.8	14.8			
COTTON	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	14.8	14.8	14.8			
BARANI	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0			
SIND																		
RICE	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.83	14.83	14.83			
COTTON	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	14.83	14.83	14.83			
NWFP																		
IRRIGATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
UN-IRRIGATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
BALUCHISTAN	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	19.77	19.77	19.77	0.00	0.00	0.00			

Table 12. Continued (b) Rabi Crops

CROP ZONE	Wheat			Barley			Tobacco			Gram		
	S	M	L	S	M	L	S	M	L	S	M	L
PUNJAB												
RICE	28.0	20.4	26.0	0.0	0.0	0.0	69.2	49.4	59.3	0.0	0.0	0.0
SUGARCANE	49.4	33.8	35.2	0.0	0.0	0.0	19.0	22.4	13.8	0.0	0.0	0.0
COTTON	37.1	40.8	35.5	0.0	0.0	0.0	19.0	22.4	13.8	0.0	0.0	0.0
BARANI	0.0	0.0	0.0	0.0	0.0	0.0	19.0	22.4	13.8	0.0	0.0	0.0
SIND												
RICE	28.00	20.39	25.97	0.00	0.00	0.00	69.19	49.42	59.30	0.00	0.00	0.00
COTTON	37.07	40.77	35.53	0.00	0.00	0.00	18.98	22.41	13.84	0.00	0.00	0.00
NWFP												
IRRIGATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
UN-IRRIGATED	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
BALUCHISTAN	9.88	9.88	9.88	9.88	9.88	9.88	18.98	22.41	13.84	19.77	19.77	19.77
PUNJAB												
RICE	0.0	0.0	0.0	19.8	19.8	19.8	0.0	0.0	0.0	14.8	14.8	14.8
SUGARCANE	0.0	0.0	0.0	19.8	19.8	19.8	0.0	0.0	0.0	14.8	14.8	14.8
COTTON	0.0	0.0	0.0	26.1	30.3	23.6	0.0	0.0	0.0	14.8	14.8	14.8
BARANI	0.0	0.0	0.0	19.8	19.8	19.8	0.0	0.0	0.0	0.0	0.0	0.0
SIND												
RICE	0.0	0.0	0.0	19.77	19.77	19.77	0.0	0.0	0.0	14.83	14.83	14.83
COTTON	0.0	0.0	0.0	26.14	30.27	23.57	0.0	0.0	0.0	14.83	14.83	14.83
NWFP												
IRRIGATED	0.0	0.0	0.0	19.77	19.77	19.77	0.0	0.0	0.0	0.00	0.00	0.00
UN-IRRIGATED	0.0	0.0	0.0	19.77	19.77	19.77	0.0	0.0	0.0	0.00	0.00	0.00
BALUCHISTAN	0.0	0.0	0.0	19.77	19.77	19.77	0.0	0.0	0.0	0.00	0.00	0.00

9. Input Prices

9.1 Fertilizer Prices

The prices of fertilizer are either directly controlled by the government or influenced indirectly through the action of the public sector fertilizer marketing institutions. The same price of fertilizer is applicable throughout the country, except the transportation cost that varies to some extent from region to region.

The price of nitrogenous fertilizer in our estimate is for Urea. Since this fertilizer comes in bags of two different sizes (of 50 and 46 kg) an average price per kilogram was calculated by dividing the respective bag by its weight and nitrogen contents.

The price of phosphorus is an average price of phosphorus contents in diammonium phosphate (DAP) and sulphate of potash (SOP). The latter is taken as a residual after deducting the respective cost of nitrogen contents valued at urea-nitrogen price. The DAP contains 23% of nitrogen while SOP contains 11.5% of the same. Using these proportions of nitrogen in various fertilizers, we could calculate the amount of nitrogen in all types of fertilizers. These quantities so obtained were multiplied by the price of urea to estimate the cost of nitrogen in various fertilizers. Subtracting these costs from their respective price per bag and dividing the respective phosphorus contents in one bag would give us the price of phosphorus in each type of fertiiizer. The average of phosphorus prices for DAP and SOP was taken to be the representative price of phosphorus.

The price of potash was estimated by dividing the cost of one bag of potash with its weight and potash content. Normally one bag of potash contain 23% potash.

The estimated prices of nitrogen, phosphorus, and potash for the year 1987-88 are 5.783, 4.847, and 2.52 rupees per killogram respectively.

9.2 Interest and Credit

The Agricultural Statistic of Pakistan, 1988-89 reports different types of institutional loans supplied to the farmers in Pakistan. However, the use of credit for different crops by size-category is not available. This study calculated credit cost equal to the interest on the total cash outlays plugged for the season of the crop. No distinction is made among hte sources of the cash used such as borrowed or owned or whether the amount is borrowed from individuals or institutions. This approach though enables one to identify the total credit requiremens, it does not help in determining the credit needs to be met by institutional sources over and obove the cash supplied by the farmer himself. Because the cash requirements of different size category is different, the interest cost varies by size category depending upon the cost of the cash inputs used. The cost on the cash inputs include expenditure on fertilizer, pesticides, seed, hired labor, tractor and threshing cost. The interest rate used through out the study period is assumed to be 12 percent.

9.3 Price of Farm Capital

Tractor, tubewell, thresher, and farm implements are the main type of capital employed on the farm. The depreciation and maintinance costs of implements are accounted for by including the payment to artisan as a cost. The cost of per hour use of tractor, tubewell and thresher are calculated in a manner to include depreciation, interest cost on investment, operational cost, and labor charges for operating them. Average cost of operating tractors, tubewells and threshers are calculated in the Tables 13, 14 and 15, respectively. No distinction is made between the hired and owned tubewell and tractor in these estimates.

The per unit costs of supplimentary water, tractor, and thresher used in our estimates are not varied by size category. However, these rates are varied by region owing to differences in proportions of electric and diesel tubewells used and in wages of operators in different regions.

9.4 Land Rent

Land is treated as fixed input. The given amount of land in a region is therefore available at zero price. However, when land is a binding constraint in a region, the dual value of the solution of linear programming would give the shadow price of land.

9.5 Wage Rate

The wage rate in Punjab for 1987-88 is taken to be Rs.30.29 per man/day. (Farm Accounts Family Budgets of Rural Families and Cost

TABLE 13. CALCULATIONS OF AVERAGE HOURLY COST OF USING TRACTOR WITH PLOUGH IN PAKISTAN, 1983-84 TO 1988-89

COST ITEMS	1988-89	1987-88	1986-87	1985-86	1984-85	1983-84
OPERATIONAL COST PER HOUR OF TRACTOR						
MARKET PRICE OF TRACTOR	195900	169900	143900	131500	112900	101757
SALVAGE VALUE	19590	16990	14390	13150	11290	10175.7
SERVICE LIFE (TOTAL LIFE IN HRS)	10000	10000	10000	10000	10000	10000
PER YEAR SERVICE (HRS)	1000	1000	1000	1000	1000	1000
DIESEL CONSUMTION (LITERS/HR)	5.15	5.15	5.15	5.15	5.15	5.15
PRICE PER LITRE	3.88	3.20	2.88	3.15	3.00	2.75
FUEL COST/HOUR	19.98	16.48	14.83	16.22	15.45	14.16
DEPRECIATION COST/HOUR	17.63	15.29	12.95	11.84	10.16	9.16
INTEREST PER ANNUM	0.12	0.12	0.11	0.11	0.10	0.10
INTEREST COST/HOUR	12.93	10.75	8.71	7.59	6.21	5.60
LUBRICATION COST/HOUR (10% OF FUEL COST)	2.00	1.65	1.48	1.62	1.55	1.42
REPAIR/SPARE COST/HOUR.	19.59	16.99	14.39	13.15	11.29	10.18
COST OF BUILDING MATERIAL INDEX (CBMI)	1.00	0.89	0.76	0.72	0.69	0.65
SHED COST/HR (1988-89 COST INDEXED WITH CBMI)	0.94	0.83	0.72	0.68	0.65	0.61
CONSUMER PRICE INDEX WITH (CPI)	1.00	0.91	0.86	0.84	0.81	0.75
LABOR PROPORTION HIRED FOR OPERATING TRACTOR	0.30	0.30	0.30	0.30	0.30	0.30
LABOUR COST/HOUR	1.14	1.03	0.94	0.87	0.79	0.72
TOTAL COST OF TRACTOR USE PER HOUR	74.21	63.02	54.02	51.97	46.10	41.84
OPERATIONAL COST PER HOUR OF CULTIVATOR/MOLDBO						
MARKET PRICE OF CULTIVATOR.	7195	6618	6015	5555	5339	5146
GENERAL PRICE INDEX WITH 1988-89 BASE	1.00	0.92	0.84	0.77	0.74	0.72
SALVAGE VALUE	720	662	602	556	534	515
SERVICE LIFE (TOTAL LIFE IN HRS)	2500	2500	2500	2500	2500	2500
PER ANNUM SERVICE (HRS)	500	500	500	500	500	500
DEPRECIATION COST/HOUR	2.59	2.38	2.17	2.00	1.92	1.85
INTEREST PER ANNUM	0.12	0.12	0.11	0.11	0.10	0.10
INTEREST COST/HOUR	0.95	0.84	0.73	0.64	0.59	0.57
REPAIR/SPARE COST/HOUR (40% OF PURCHASE PRICE)	1.15	1.06	0.96	0.89	0.85	0.82
TOTAL COST OF CULTIVATOR/HR	4.69	4.28	3.86	3.53	3.36	3.24
TOTAL COST OF TRACTOR CULTIVATOR/HR	78.90	67.30	57.87	55.50	49.46	45.09

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TABLE 14. CALCULATION OF AVERAGE HOURLY COST OF TUBEWELL USE IN PAKISTAN, 1983-84 TO 1988-89

COST ITEMS	1988-89	1987-88	1986-87	1985-86	1984-85	1983-84
OPERATIONAL COST PER HOUR OF ONE CUSEC CAPICITY ELECTRIC TUBEWELL						
INSTALATION COST.	47560	45182	42923	40777	38738	36801
SALVAGE VALUE	4480	4256	4043	3841	3649	3467-
SERVICE LIFE (TOTAL LIFE HRS)	22860	22860	22860	22860	22860	22860
ELECTRICITY CONSUMTION/HOUR	8.95	8.95	8.95	8.95	8.95	8.95
PRICE PER UNIT.(PAISA)	0.40	0.35	0.29	0.25	0.23	0.23
ELECTRICITY COST/HOUR	3.61	3.13	2.60	2.24	2.06	2.06
DEPRECIATION COST/HOUR.	1.88	1.79	1.70	1.62	1.53	1.46
INTEREST PER ANNUM	0.12	0.12	0.11	0.11	0.10	0.10
INTEREST COST/HOUR.	1.23	1.12	1.02	0.92	0.83	0.79
REPAIR/SPARE COST/HOUR (3.59% OF INSTALLATION)	0.67	0.64	0.61	0.58	0.55	0.52
SHED COST/HOUR.	1.13	1.00	0.86	0.82	0.78	0.74
LABOUR COST/HOUR.	0.95	0.86	0.78	0.72	0.66	0.60
TOTAL COST/HR	9.47	8.54	7.56	6.89	6.42	6.17
ELECTRIC TUBEWELLS	75621	74838	74143	71834	70922	
PROPORTION OF ELECTRIC TUBEWELLS	0.30	0.32	0.33	0.33	0.36	
WEIGHTED AVERAGE PRICE OF ELECTRIC	2.56	2.40	2.28	2.14	2.21	
OPERATIONAL COST PER HOUR OF ONE CUSEC CAPICITY DIESEL TUBEWELL						
INSTALATION COST	63500	60500	57500	54500	51500	48500
SALVAGE VALUE	6147	5856	5566	5276	4985	4695
SERVICE OF TUBEWELL (HRS/YEAR)	1839	1839	1839	1839	1839	1839
NO. OF YEARS SERVED	9	9	9	9	9	9
SERVICE LIFE (TOTAL HRS)	16551	16551	16551	16551	16551	16551
DIESEL CONSUMTION (LITERS/HR)	2.62	2.62	2.62	2.62	2.62	2.62
PRICE PER LITRE.	3.88	3.2	2.88	3.15	3.15	3.15
FUEL COST/HOUR.	10.17	8.38	7.55	8.25	8.25	8.25
DEPRECIATION COST/HOUR	3.47	3.30	3.14	2.97	2.81	2.65
INTEREST PER ANNUM	0.12	0.12	0.11	0.11	0.10	0.10
INTEREST COST/HOUR.	2.27	2.07	1.89	1.71	1.54	1.45
LUBRICATION COST/HOUR (1% OF FUEL COST)	0.10	0.08	0.08	0.08	0.08	0.08
REPAIR/SPARE COST/HOUR.(4.95% OF INSTALATION)	1.71	1.63	1.55	1.47	1.39	1.31
SHED COST/HOUR.	1.13	1.00	0.86	0.82	0.78	0.74
LABOR WAGE INDEX	1.00	0.91	0.83	0.76	0.70	0.63
PROPORTION OF HIRED LABOR FOR T.W.	0.25	0.25	0.25	0.25	0.25	0.25
LABOUR COST/HOUR.	0.95	0.86	0.78	0.72	0.66	0.60
TOTAL COST.	19.79	17.34	15.84	16.02	15.51	15.07
NUMBER OF DIESEL TUBEWELLS	176431	160568	149703	143646	127389	
PROPORTION OF DIESEL TUBEWELLS	0.70	0.68	0.67	0.67	0.64	
WEIGHTED AVERAGE PRICE/HOUR OF DIESEL TUBEWELL	12.13	10.80	10.72	10.34	9.68	
WEIGHTED AVERAGE PRICE/HOUR (DISEL+ELECTRIC)	14.70	13.21	13.00	12.48	11.89	

TABLE 15. CALCULATION OF AVERAGE HOURLY COST OF THRESHER OPERATION IN PAKISTAN, 1983-84 TO 1988-89

COST ITEMS	1988-89	1987-88	1986-87	1985-86	1984-85	1983-84
MARKET PRICE OF THRESHER.	24000	21840	20400	18480	18000	17760
GENERAL PRICE INDEX WITH THE BASE 1988-89	1.00	0.91	0.85	0.77	0.75	0.74
SALVAGE VALUE	2400	2184	2040	1848	1800	1776
SERVICE LIFE (TOTAL LIFE IN HRS)	2500	2500	2500	2500	2500	2500
DEPRECIATION COST/HOUR.	8.64	7.86	7.34	6.65	6.48	6.39
RATE OF INTEREST (RS/HR)	0.12	0.115	0.11	0.105	0.10	0.10
INTEREST COST/HOUR.	3.17	2.763	2.47	2.134	1.98	1.95
REPAIR/SPARE COST/HR	2.40	2.18	2.04	1.85	1.80	1.78
PROPORTION OF LABOR HIRED	1	1	1	1	1	1
LABOR COST (RS/HR)	3.79	3.44	3.13	2.88	2.64	2.40
TOTAL COST OF THRESHER/HR	17.99	16.25	14.98	13.52	12.90	12.52

of Production of Major Crops in Punjab, 1987-88). For Sind and NWFP, it is assumed to be 10% percent less than that in Punjab. In the case of Baluchistan the relevant figure is 20% less than the same in Punjab. The wage rate for all size categories, crops, and regions within a province are assumed to be equal.

9.6 Pesticide price

The price of one spray on cotton in Punjab during 1987-88 is estimated to be Rs. 205.14 including the cost of labor and sprayer
machine (Farm Accounts Family Budgets of Rural Families and Cost of Production of Major Crops in Punjab, 1987-88). The price of spray for the earlier years were deflated with the price index of pesticides. The latter was developed by dividing the value with the amount of pesticides imported. The pesticide price indices for 1983-84, 1984-85, 1985-86, 1986-87, and 1987-88 are Rs.0.57, Rs.0.67, Rs.0.72, Rs.0.81, and Rs.1.00, respectively. It is assumed that the pesticide price per spray are the same for all crops in all regions and for all size categories.

10. Product Prices

In Punjab, the product prices developed for a region are the weighted average of the district-wise farm gate prices. Wherever farm-gate prices were not available, especially in case of minor crops, district-wise wholesale prices were converted into farmgate assuming marketing margins. To develop weighted average prices by region, the weights used were the relative shares of various districts in production of a crop in a region. In cases where crops were aggregated ones (eg oilseeds or pulses), first a weighted average district-wise prices for the aggregated crops were estimated based on production share of the minor crops in the aggregated crop. Those prices were then further aggregated for the region using the same procedure adopted for individual crops. Kharif vegetables used the weighted average of chillies, coriander, and turmeric. Whereas for Rabi vegetables we took the weighted average of potatoes, onions, sugarbeets and peas. For fruit the weighted average price was calculated by using the prices of mango, banana, and citrus.

For Sind, the district-wise farm-gate prices were not readily available. We, therefore, took the wholesale prices at one of the major marketing centres in the region to calculate the necessary data. However, in order to get the district wise farm gate prices the wholesale prices were discounted for the marketing margins between the wholesale market and the farm gate. The marketing margins of different crops are reported in Table 16. The marketing margins are assumed not to change throughout the study period. For the cotton region, Hyderabad market prices, and for the rice region, Larkana market prices are used. The procedure to estimate a weighted average price for the aggregated crop (eg oilseed and pulses), is similar to that in Punjab, except that the aggregation is done only for different type of crops, and not for districts. For fruits, weighted average price was calculated by using prices of mango and banana as these are the two major fruits grown in that province.

In Baluchistan, the wholesale prices at Quetta market were converted into farm-gate prices using the same marketing margin as in the case of Sind. Different type of vegetables, pulses, and oilseeds were aggregated using a methodology similar to the one used in Punjab and Sind. Fruit prices were taken to be the weighted average of prices for apple, plums and grapes, the three most important fruits grown in that region.

ANNEX V

LIVESTOCK IN PAKISTAN'S AGRICULTURAL SECTOR MODEL (PASM)

ANALYSIS OF CORPORATE SECTOR CONSTRAINTS IN AGRICULTURE

LIVESTOCK IN PAKISTAN'S AGRICULTURAL SECTOR MODEL (PASM)

DRAFT REPORT (Revised)

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LIVESTOCK IN PAKISTAN'S AGRICULTURAL SECTOR MODEL

Pakistan Agricultural Sector Model (PASM) is an attempt to arrive at optimal allocation of resources in Pakistan's agriculture to meet demand for various goods and services produced by this sector. This exercise is carried out in a linear programming framework in which inter-linkages between different activities are specified to maximize a given objective function. One sub-sector of the model relates to livestock activities. Like other activities in the model, this sub-sector is both the user of resources (mainly feed) and supplier of products such as meat, milk, eggs and hides and skins. Accordingly we need to determine the resource requirements of this sub-sector for obtaining different levels of livestock and other agricultural outputs. This note deals mainly with the feed requirements.

Section I of this note presents a profile of livestock sector in Pakistan. In section II we describe how the basic data required to calculate feed rations were constructed. Section III explains the method of calculating alternative feed rations on the basis of the data in earlier sections. Estimates of feed rations for various categories of animals are presented in section IV.

SECTION I. A PROFILE OF LIVESTOCK SUB-SECTOR IN PAKISTAN

I.1. According to 1989-90 estimates, about 7% of GNP in Pakistan is contributed directly by livestock products such as meat, fresh milk, eggs and hides and skins [3]. The share of livestock-based agribusiness activities, though not exactly known, is believed to be equal to the direct contribution of this sub-sector[1].

I.2. According to census data on livestock, the total number of animals in different categories in 1987/88 would have been as follows: a) Cattle 17.5O million; b) Buffaloes 16.99 million; c) Sheep 24.72 million; and d) Goats 31.81 million (Table 1). These numbers include males, females,adults and young stock.

I.3. The provincial breakdown of livestock data is provided in Tables 2 to 5.

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[1] For agribusiness as a whole, it is estimated that their contribution to GNP is almost equal to the direct contribution of the agricultural sector in Pakistan [EAN].

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Table 1

LIVESTOCK HEADS BY CATEGORY OF ANIMALS, AND ZONES, 1987-88
ALL PROVINCES
****

(Heads in Thousands)

Crop Zones	Cattle	Buffalo	Sheep	Goat	Total Animal Heads	%
PUNJAB	8,275	11,456	5,751	10,614	36,096	39.66%
SIND	4,240	4,011	3,409	9,652	21,312	23.42%
NWFP	3,705	1,445	1,851	3,380	10,381	11.41%
BALOCHISTAN	1,275	75	13,711	8,167	23,228	25.52%
GRAND TOTAL	17,495	16,987	24,723	31,813	91,018	100.00%

(PERCENTAGE DISTRIBUTION)
****

PUNJAB	47.30%	67.44%	23.26%	33.36%
SIND	24.24%	23.61%	13.79%	30.34%
NWFP	21.18%	8.51%	7.49%	10.62%
BALOCHISTAN	7.29%	0.44%	55.46%	25.67%
TOTAL	100.00%	100.00%	100.00%	100.00%

Source: Data from Livestock Census, 1986, were extrapolated using growth rates of respective livestock categories between 1980 to 1986.

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Table 2

PUNJAB

(Heads in Thousands)

Crop Zone	Cattle	Buffalo	Sheep	Goat	Total Animal Heads	%
RICE	1,306	3,871	547	1,594	7,318	20.27%
SUGARCANE	1,126	2,131	575	2,068	5,901	16.35%
COTTON	4,714	5,076	4,225	5,085	19,100	52.92%
BARANI	1,128	378	404	1,867	3,777	10.46%
	8,275	11,456	5,751	10,614	36,096	100.00%

(PERCENTAGE DISTRIBUTION)
****

RICE	15.79%	33.79%	9.51%	15.02%
SUGARCANE	13.61%	18.60%	10.00%	19.48%
COTTON	56.97%	44.30%	73.47%	47.91%
BARANI	13.63%	3.30%	7.30%	17.58%
TOTAL	100.00%	100.00%	100.00%	100.00%

Source: Data from Livestock Census, 1986, were extrapolated during growth rates of respective livestock categories between 1980 to 1986.

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Table 3

LIVESTOCK HEADS BY CATEGORY OF ANIMALS, AND ZONES, 1987-88
SIND

(Heads in Thousands)

Crop Zones	Cattle	Buffalo	Sheep	Goat	Total Animal Heads	%
RICE	1,705	1,579	1,370	2,405	7,058	33.12%
COTTON	2,536	2,432	2,040	7,246	14,254	66.88%
TOTAL	4,240	4,011	3,409	9,652	21,312	100.00%

(PERCENTAGE DISTRIBUTION)

RICE	40.20%	39.37%	40.17%	24.17%
COTTON	59.80%	60.63%	59.83%	75.08%
TOTAL	100.00%	100.00%	100.00%	100.00%

Source: Data from Livestock Census, 1986, were extrapolated using growth rates of respective livestock categories between 1980 to 1986.

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Table 4

LIVESTOCK HEADS BY CATEGORY OF ANIMALS, AND ZONES, 1987-88
NWFP
****

(Heads in Thousands)

Crop Zones	Cattle	Buffalo	Sheep	Goat	Total Animal Heads	%
NWFP IRRIGATED	2,300	809	1,292	1,567	5967	57.48%
NWFP UN-IRRIGATED	1,405	636	559	1,813	4414	42.52%
TOTAL	3,705	1,445	1,851	3,380	10,381	100.00%

(PERCENTAGE DISTRIBUTION)
****

NWFP IRRIGATED	62.09%	55.98%	69.78%	46.35%
NWFP UN-IRRIGATED	37.91%	44.02%	30.22%	53.65%
TOTAL	100.00%	100.00%	100.00%	100.00%

Source: Data from Livestock Census, 1986, were extrapolated using growth rates of respective livestock categories between 1980 to 1986.

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Table 5

LIVESTOCK HEADS BY CATEGORY OF ANIMALS, AND ZONES, 1987-88
BALOCHISTAN
****

(Head in Thousands)

Crop Zone	Cattle	1987-88 Buffalo	Sheep	Goat	Total Animals Heads	%
Balochistan	1,275	75	13,711	8,167	23,228	100.00%

(PERCENTAGE DISTRIBUTION)
****

BALOCHISTAN	100.00%	100.00%	100.00%	100.00%

Source: Data from Livestock Census, 1986, were extrapolated using growth rates of respective livestock categories between 1980 to 1986.

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Accordingly of the total animal heads (cattle, buffaloes, sheep and goats) there were 39.66% in Punjab; 23.42% in Sind; 11.41% in NWFP and 25.52% in Balochistan. At the level of individual livestock category, there were relatively more buffaloes than cattle in Punjab whereas the opposite was true for the other three provinces. In Balochistan the number of buffaloes was the smallest (only 75000) giving a cattle-buffalo ratio of 17 (in comparison to only 0.72 for Punjab).

Balochistan is also distinct on account of its large population of sheep and goats. Its sheep population is the highest of any province in the country and comes to about 55.4% of the total.

I.4. The size of poultry (both commercial and non-commercial) for the country as a whole stands at 150.4 million birds.[2] Of this, about 62% are 'commercial' birds and the rest are non-commercial ones. At the provincial level, in 1987/88, there were 48.8% birds in Punjab , 16% in Sindh, 29.6% in NWFP and 5.6% in Balochistan (Table 6). It is interesting to note that NWFP has the highest rate of poultry growth between 1980 and 1987/88. Its share in total poultry population is much more than its share in other categories of livestock. (See Table 1 again).

I.5. The total output of livestock in 1987-88 was as follows:

Meat (sheep and goats): 570,000 tones; beef (cattle and buffaloes): 595,000 tones: fresh milk (from all milking animals): 10437 tones: poultry meat: 154,000 tones: and number of eggs: 4.14 billion [Table 7]. Hides and skins from sheep and goats were 34.02 million and from cattle and buffaloes 5.66 million [3].

All these data presented in Table 7 were required to estimate average productivity of livestock associated with a given feed ration.

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[2] This figure is higher than the one reported in 1986 Census of Livestock. It is based on the data reported in the Agricultural Statistics of Pakistan, 1988-89, and supported by figures on poultry consumption reported in the Household Income and Expenditure Surveys of recent years.

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Table 6

COMMERCIAL AND NON-COMMERCIAL POULTRY BIRDS IN PAKISTAN, 1987-88

	Share in Total Poultry Population	Total Population of Birds*	Commercial Poultry	Non-Commercial Poultry
	(%)	(millions)		
PAKISTAN	100.00	150.40	93.46	56.94
Punjab	48.80	73.40	44.57	28.83
Barani Zone	6.10	9.17	5.57	3.60
Sugarcane Zone	8.90	13.39	8.13	5.26
Cotton Zone	19.40	29.18	17.72	11.46
Rice Zone	14.40	21.66	13.15	8.51
Sind	16.00	24.06	17.52	6.54
Rice Zone	10.50	15.79	11.50	4.29
Cotton Zone	5.50	8.27	6.02	2.25
NWFP	29.60	44.52	25.52	19.37
Irrigated	22.25	33.46	18.90	14.56
Unirrigated	7.35	11.06	6.25	4.81
Balochistan	5.60	8.42	6.22	2.20

Source: Estimates based on Livestock Census, 1986 and Agricultural Statistics Pakistan 1988-89.

* Total bird population in this table was taken from Pakistan Agricultural Statistics, 1988-89. The total was then distributed to zones according to their shares calculated from data reported in the Pakistan Census of Livestock, 1986.

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Table 7

TOTAL LIVESTOCK OUTPUT IN PAKISTAN BY PROVINCE AND ZONE 1987-88
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Region/Zone	(000 tonnes) Milk	Beef	Meat	Poultry Meat	Eggs (million)
Pakistan	10437	595.00	570.00	154.00	4140.00
Punjab	6219	338.30	241.70	75.15	2020.00
Rice	1824	83.80	26.00	22.18	596.00
Sugarcane	1080	54.40	37.40	13.71	368.00
Cotton	2951	170.60	143.60	29.88	803.00
Barani	364	28.50	34.70	9.39	253.00
Sind	2427	145.3	201.3	24.64	663
Rice	962	57.90	58.20	16.17	435.00
Cotton	1465	87.40	143.10	8.47	228.00
NWFP	1279	96.30	80.8	45.58	1225.00
Irrigated	758	58.50	44.80	34.27	921.00
Unirrigated	521	37.80	36.00	11.32	3.40
Balochistan	511	15.90	46.37	8.62	232.00

Source: Based on Zone-wise livestock data in Tables 2 and 5 livestock output data from Agricultural Statistics [4]:

SECTION II. ESTIMATING FEED RATIONS

II.1. A ration is the amount of feed required by any animal to maintain a certain level of body weight and productivity. As far as the present level of productivity is concerned, it should be true by definition that the total population of livestock is being maintained by the existing supply of total feed (from all sources). Any increase in feed would result in either increase in productivity or the population or both. Changes in livestock population or productivity could also take place if the proportions in which different categories of feed used in preparing the ration are changed. This is so because not all categories of feed have the same nutritional value, measured in terms of TDN (Total Digestible Nutrients) and DP (Digestible Protein). [2]

II.2. For our model we have estimated three types of feed rations. First, rations based on present availability of feed. Here the weights of different components of feed are equal to their share in the present production of feed in the country. The second and third types of rations are for different levels of productivity of meat, milk and eggs (see section III for details).

II.3. To calculate different rations we needed the following data:

a) Total availability of feed from various sources.
b) Total number of standard animal units.

Feed Availability from Various Sources

II.3.1 In Pakistan there are six types of animal feed. They are:

(i) Grains or finished product from a crop (e.g., gram, cotton seed and low quality wheat are all feed to milking animals. Similarly Gur is also used in winter times. Paddy is fed to horses. Broken rice, maize and other coarse grains are feed to poultry);

(ii) Bran: Besides direct feeding of grains and finished products, bran from all crops is a very widely used feed for all category of animals;

(iii) Feed cakes from all types of oil seeds;

(iv) Straw (dry matter) from all crops except perhaps cotton;

(v) Cut green fodder which includes green fodder crops (Barseem, maize, sorgem etc.), a proportion of crops such as wheat used as green fodder before harvesting, and green topping from sugarcane; and

(vi) Grass, both cut and from grazing.

II.3.2 It was assumed that the first five categories of feed are derived in certain proportions from almost all the crops grown in a season. As regards grass, its exact quantity is not known. According to some estimates it is about twice the total feed derived from all other sources (Sial et.al). Although this figure is not more than a guess estimate, some support to this is available from the Census of Livestock, 1986. According to this source the proportion of livestock raised on 'pure grazing', and grazing plus other feeds' in Pakistan is about two- third of the total livestock. Accordingly we assumed that at the aggregate level, grass availability is two times the feed available from all other sources. At the level of individual zones, however, the grass to 'other feed' ratio was taken to be in the range of 1.75 to 5. This was done by keeping in view the size of pasture land in various zones. Table 8 contains details of the ratios used in this context.

II.3.3 The proportion in which different types of feed are derived from various crops are presented in Table 9.[3] Estimates of total feed from different sources are presented in Table 10 to 14. Before estimating feed rations from these data, the share of poultry was separated as the nature of rations for this category of livestock was quite different from animals.

II.3.4 Poultry Feed is composed of items drawn from crops and non-crop sources. These latter include fish and other meals, minerals, salts and vitamins. In our model we separated a portion of crop-based poultry feed from the total crops and combined the same with non-crop feeds to define rations for poultry. The amount of total poultry feed

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[3] These proportions were arrived at after discussion with experts at NARC and by keeping in view the feed estimates in Sial et.al [10], Qureshi [8] and Pakistan [5].

Table 8

THE AMOUNT OF GROSS AVAILABLE IN RELATION TO ONE UNIT OF 'OTHER FEED' (GRASS - 'OTHER FEED' RATIO) IN DIFFERENT ZONES IN PAKISTAN, 1987 - 88

****

Region/Zone	Kharif	Rabi
Punjab		
Barani	5.25	5.25
Cotton	1.75	1.75
Rice	1.75	1.75
Sugarcane	1.75	1.75
Sind		
Rice	2.5	1.75
Cotton	2.5	1.75
NWFP		
Irrigated	2.5	2.5
Unirrigated	5.25	5.25
Balochistan	5.25	5.25
Pakistan	2.0	2.0

Note: See paragraph II 3.2 of the text for the basis of obtaining these ratios

Table 9

THE PROPORTION OF VARIOUS CROPS USED AS ANIMAL FEED (FEED CONVERSION FACTORS)

KHARIF SEASON

(%)

RATION CATEGORY/ SOURCES	Rice(B)	Rice(O)	C.Grain	Cotton	Sugar cane	Oil Seed	Pulses
Direct Feeding	0.02	0.02	0.26	0.07	0.01	0.05	0.05
Bran	0.10	0.10	0.14	0.07	0.00	0.00	0.20
Cake	0.00	0.00	0.00	0.50	0.00	0.75	0.00
Straw	1.50	1.00	1.50	0.00	0.10	1.00	1.00
Green	0.02	0.02	0.02	0.02	0.33	0.10	0.10

RABI SEASON

(%)

RATION CATEGORY/ SOURCES	Wheat	Barley	Pulses	Vege-tables	OILSEED Rapeseed & Mustard	Fodder
Direct Feeding	0.10	0.15	0.12	0.05	0.12	0.00
Bran	0.15	0.15	0.20	0.00	0.00	0.00
Cake	0.00	0.00	0.00	0.00	0.75	0.00
Straw	1.25	1.25	1.25	0.00	1.25	0.00
Green	0.05	0.10	0.05	0.10	0.25	1.00

Table 10

TOTAL GROSS AVAILABILITY OF FEED BY TYPE OF FEED IN 1987-1988
ALL FOUR PROVINCES

('000 Tonnes)

Kharif

Region	Bran & Grain	Oilseed Cake	Straw	Green Fodder	Grass
Punjab	1367.5	1973.5	6214.4	19085.7	34273.0
Sind	527.6	373.6	3558.0	5115.1	12787.7
NWFP	354.6	9.4	1696.1	2481.5	7813.4
Balochistan	66.1	0.7	439.9	87.9	461.5
Grand Total	2315.8	2357.2	11908.5	26770.2	55335.6

Rabi

Region	Bran & Grain	Oilseed Cake	Straw	Green Fodder	Grass
Punjab	2373.9	96.5	11704.0	28561.3	50497.8
Sind	606.5	34.7	2947.4	3526.9	6172.2
NWFP	296.1	9.5	1261.2	1869.5	7101.8
Balochistan	121.5	9.8	544.8	49.7	260.7
Grand Total	3398.0	150.5	16457.4	34007.4	64032.5

Sources of data for Tables 10 to 14. Estimates based on data from Pakistan [4] and Tables 8 and 9.

Table 11

TOTAL GROSS AVAILABILITY OF FEED BY TYPE OF FEED IN 1987-1988
PUNJAB
****

('000 Tonnes)

Zone	Bran & Grain	Oilseed Cake	Straw	Green Fodder	Grass
	Kharif				
Rice	300.0	15.0	2641.9	3662.9	6410.0
Sugarcane	191.9	89.9	1150.2	4710.2	8242.8
Cotton	845.1	1848.2	2287.1	10463.2	18310.6
Barani	30.5	20.5	135.3	249.5	1309.6
Total	1367.5	1973.5	6214.4	19085.7	34273.0
	Rabi				
Rice	550.9	14.9	2710.0	8731.6	15280.3
Sugarcane	329.5	10.4	1620.0	6160.3	10780.6
Cotton	1419.1	65.5	7002.0	13522.1	23663.7
Barani	74.4	5.7	372.0	147.3	773.3
Total	2373.9	96.5	11704.0	28561.3	50497.8

Source: See Table 10.

Table 12

TOTAL GROSS AVAILABILITY OF FEED BY TYPE OF FEED IN 1987-1988
SIND
****

('000 Tonnes)

Zone	Bran & Grain	Oilseed Cake	Straw	Green Fodder	Grass
	Kharif				
Rice	318.3	6.4	2664.7	1951.6	4879.0
Sugarcane	209.3	367.2	893.3	3163.5	7908.7
Total	527.6	373.6	3558.0	5115.1	12787.7
	Rabi				
Rice	116.5	12.0	539.0	1083.3	1895.8
Sugarcane	490.0	22.7	2408.4	2443.6	4276.4
Total	606.5	34.7	2947.4	3526.9	6172.2

Source: See Table 10

Table 13

TOTAL GROSS AVAILABILITY OF FEED BY TYPE OF FEED IN 1987-1988
NWFP

('000 Tonnes)

Zone	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Irrigated	232.7	1.8	1,227.1	1,896.2	4,740.5
Unirrigated	121.9	7.6	469.0	585.3	3,072.9
Total	354.0	9.4	1,696.1	2,481.5	7,813.4

Zone	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Irrigated	175.1	1.1	674.3	986.5	2,466.3
Unirrigated	121.0	8.4	586.9	883.0	4,635.5
Total	296.1	9.5	1,261.2	1,869.5	7,101.8

Source: See Table 10.

Table 14

TOTAL GROSS AVAILABILITY OF FEED BY TYPE OF FEED IN 1987-1988
BALOCHISTAN

('000 Tonnes)

	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Total	66.1	0.7	439.9	87.9	461.5

	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Total	121.5	9.8	544.8	49.7	260.7

Source: See Table 10

(taken from the RONCO/ACSCA Livestock Feed Agro-industry Research Report) was divided among zones according to their shares in total poultry population. Accordingly the estimates of different types of feed available for poultry in 1987-88 are presented in Table 15.

Since in most cases our model has been disaggregated at crop level it was necessary to calculate the shares of individual crops in total poultry feed. This calculation was particularly needed in the case of bran and grain as it was derived from many sources. Accordingly in Tables 16 to 19 we present shares of individual crops in total bran made available to poultry birds in various zones. These estimates are based on respective contributions of crops to bran and grain produced in both Rabi and Kharif seasons.

As regards feed cake it was assumed that 2% of the total availability in each zone goes to poultry. This assumption was also based on the poultry feed data taken from the RONCO/ACSCA Livestock Feed Agro-industry Research Report referred to above.

II.3.5. The estimates of net feed availability which could be used as basis for calculating feed rations for livestock other than poultry were obtained after deducting the poultry feed from the gross feed figures in Tables 10 to 14. These estimates are presented in Tables 20 to 24.

Standard Animal Units

II.3.6 The livestock population shown in Tables 1 to 5 is composed of both males and females and adults and young animals. Obviously not all of them have the same feed requirement. The estimates of animal head are therefore not suitable to calculate per unit feed rations. For this purpose first we need to convert the animal heads into some standard units. Then, depending on how the data are to be used in the model, we can either leave the rations in terms of standard units or convert them back in terms of the actual animal heads[4]

II.3.7 In our estimates we assumed one adult cow weighing 410 kg, to be equal to one standard animal unit. All other categories of animals were converted into cow (standard) units keeping in view the difference in their feed requirements vis-a-vis

[4] For illustration, if one cow is assumed to be equal to 5 goats then in order to find a ration for one goat we can divide the standard cow rations by 5 (i.e 1 cow ration = 5 goat ration or 1 goat ration = 1/5 cow ration).

Table 15

DISTRIBUTION OF POULTRY FEED BY ZONES IN PAKISTAN, 1987-88

Region/Zone	Commercial Poultry Feed: Bran & Grains (1)	Commercial Poultry Feed: Fish Meal & Other Meat Meal (2)	Commercial Poultry Feed: Cake (3)	Commercial Poultry Feed: Chemicals & Vitamins (4)	Non-Commercial Poultry Feed: Bran & Grains (5)
	(Thousands of Tonnes)				
PAKISTAN	1,148	172.5	22.96	68.88	279
Punjab	561	84.3	11.22	33.66	141
Rice Zone	166	24.9	3.32	9.96	42
Sugar Zone	103	15.5	2.06	6.18	26
Cotton Zone	223	33.5	4.46	13.38	56
Barani Zone	69	10.4	1.38	4.14	17
Sind	183	27.5	3.66	10.98	32
Rice Zone	120	18.0	2.40	7.20	21
Cotton Zone	63	9.5	1.26	3.78	11
NWFP	341	51.2	6.82	20.46	95
Irrigated Zone	256	38.4	5.12	15.36	71
Unirrigated Zone	85	12.8	1.70	5.10	24
Balochistan	63	9.5	1.26	3.78	11

* Estimates based on poultry population data for different provinces taken from Census of Livestock, 1986 and RONCO/ACSCA, Livestock Feed Agro-industry Research Report [9]

Table 16

THE PERCENTAGE DISTRIBUTION OF POULTRY FEED (BRAN & GRAIN) BY SOURCES OF FEED, 1987-88

1. PUNJAB KHARIF CROPS

ZONE/SOURCE OF RATION	Rice (B)	Rice (O)	C.Grain	Cotton	Sugar-cane	Oil-Seeds	Vege-tables	Fodder
RICE	17.03	5.35	6.62	0.00	0.00	0.00	0.00	0.00
SUGARCANE	3.18	2.30	17.37	0.00	0.00	0.00	0.00	0.00
COTTON	2.06	2.15	10.47	0.00	0.00	0.00	0.00	0.00
BARANI	0.16	0.00	24.76	0.00	0.00	0.00	0.00	0.00
TOTAL PUNJAB	6.14	2.95	10.91	0.00	0.00	0.00	0.00	0.00

2. RABI SEASON FOR THE YEAR

ZONE/SOURCE OF RATION	Wheat	Barley	Other Pulses	Vege-tables	OILSEED Rapseed & Mustard	Fodder	TOTAL
RICE	70.64	0.36	0.00	0.00	0.00	0.00	0.00
SUGARCANE	76.80	0.36	0.00	0.00	0.00	0.00	0.00
COTTON	85.00	0.30	0.00	0.00	0.00	0.00	0.00
BARANI	74.17	0.91	0.00	0.00	0.00	0.00	0.00
							10.00
TOTAL PUNJAB	79.65	0.35	0.00	0.00	0.00	0.00	0.00

Note: The total fractions are distributed by crop seasons. Accordingly the sum of the perentages under kharif and rabi for each zone is equal to 100.

Table 17

THE PERCENTAGE DISTRIBUTION OF POULTRY FEED (BRAN & GRAIN) BY SOURCES OF FEED, 1987-88

SIND KHARIF CROPS

ZONE/SOURCE OF RATION	Rice (B)	C.Grain	Cotton	(%) Sugar Cane	Oil-seeds	Pulses	Vege-tables	Fodder	All Fruits	TOTAL
RICE	76.04	1.33	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
COTTON	2.40	5.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
	30.06	3.71	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

RABI CROPS

ZONE/SOURCE OF RATION	Wheat	Barley	Pulses	Vege-tables	OILSEED Rapseed & Mustard	Fodder	TOTAL
RICE	21.25	1.01	0.00	0.00	0.00	0.00	0.00
COTTON	76.83	0.03	0.00	0.00	0.00	0.00	0.00
							10.00
TOTAL SIND	0.560	0.004	0.00	0.00	0.00	0.00	0.00

Note: The total fractions are distributed by crop seasons. Accordingly the sum of the perentages under kharif and rabi is equal to 100.

Table 18

THE PERCENTAGE DISTRIBUTION OF POULTRY FEED (BRAN & GRAIN) BY SOURCES OF FEED, 1987-88

NWFP KHARIF CROPS

ZONE/SOURCE OF RATION	Rice (B)	Rice (O)	C.Grain	Cotton (%)	Sugar-cane	Oil-seeds	Pulses
IRRIGATED	1.25	4.88	52.56	0.00	0.00	0.00	0.00
IM-IRRIGATED	0.00	0.00	36.81	0.00	0.00	0.00	0.00
TOTAL NWFP	0.74	2.88	52.74	0.00	0.00	0.00	0.00

NWFP RABI CROPS

ZONE/SOURCE OF RATION	Wheat	Barley	Pulses	Vege-tables (M.TONS)	Rapseed & Mustard	Fodder	TOTAL
IRRIGATED	21.86	1.45	0.00	0.00	0.00	0.00	0.00
UN-IRRIGATED	42.18	4.82	0.00	0.00	0.00	0.00	0.00
							10.00
TOTAL SIND	0.408	0.028	0.000	0.000	0.000	0.000	0.000

Note: The total fractions are distributed by crop seasons. Accordingly the sum of the perentages under kharif and rabi is equal to 100.

Table 19

THE PERCENTAGE DISTRIBUTION OF POULTRY FEED (BRAN & GRAIN) BY SOURCES OF FEED, 1987-88

1. BALOCHISTAN KHARIF CROPS

(%)

ZONE/SOURCE OF RATION	Rice (B)	C.Grain	Cotton	Sugar Cane	Oil seed	Pulses	Vege-tables	Fodder	All Fruits	TOTAL
BRAN & GRAIN	2.30	28.00	1.40	0.00	0.00	0.00	0.00	0.00	0.00	0.00

2. RABI SEASON FOR THE YEAR

ZONE/SOURCE OF RATION	Wheat	Barley	Pulses	Vege-tables	Rapseed & Mustard	Fodder	TOTAL
BRAN & GRAIN	65.90	2.40	4.20	0.00	0.00	0.00	0.00

Note: The total fractions are distributed by crop seasons. Accordingly the sum of the perentages under kharif and rabi is equal to 100.

Table 20

TOTAL NET AVAILABILITY OF FEED BY TYPE OF FEED 1987-1988
ALL PROVINCES
(000 tonnes)

Zone/Region	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Punjab	1,215.3	1,894.6	5,965.9	18,099.2	30,845.7
Sind	413.0	358.7	3,415.7	4,910.5	11,508.9
NWFP	80.1	9.0	1,579.5	2,381.6	7,032.1
Balochistan	40.9	0.7	381.2	83.8	415.4
Grand Total	1,749.3	2,263.0	11,342.3	25,475.1	49,802.2

Zone/Region	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Punjab	1,844.2	92.7	11,235.9	27 418.9	45 488.1
Sind	518.2	33.3	2,829.5	3,385.9	5,554.9
NWFP	109.8	9.1	1,210.7	1,794.7	6,192.9
Balochistan	70.8	9.4	523.0	47.7	234.6
Total	2,543.0	144.5	15,799.1	32,647.2	57,470.5

Sources for Tables in 20 to 24: Estimates based on data in Tables 10 to 14 and Tables 16 to 19.

Table 21

TOTAL NET AVAILABILITY OF FEED BY TYPE OF FEED 1987-1988
PUNJAB
(000 tonnes)

Zone/Region	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Rice	239.7	14.4	2,536.2	3,486.9	6,102.1
Sugarcane	162.5	86.3	1,104.2	4,460.5	7,805.9
Cotton	804.1	1,774.3	2,195.6	9,913.8	17,349.2
Barani	9.0	19.7	129.9	238.0	1,249.8
Sub-total	1,215.3	1,894.6	5,965.9	18,099.2	32,506.9

Zone/Region	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Rice	403.2	14.3	2,601.6	8,382.3	14,669.0
Sugarcane	250.1	10.0	1,555.2	5,913.9	10,349.4
Cotton	1,181.1	62.9	6,721.9	12,981.2	22,717.1
Barani	9.8	5.5	357.1	141.4	742.4
Total	1,844.2	92.7	11,235.9	27,418.9	48,477.9

Source: See Table 20

Total 22

TOTAL NET AVAILABILITY OF FEED BY TYPE OF FEED 1987-1988
SIND
****
('000 tonnes)

Zone/Region	Kharif Bran & Grain	Kharif Oilseed Cake	Kharif Straw	Kharif Green Fodder	Kharif Grass
Rice	209.2	6.2	2,558.1	1,873.6	4,683.9
Sugarcane	203.8	352.5	857.6	3,036.9	7,592.3
Total	413.0	358.7	3,415.7	4,910.5	12,276.2

Zone/Region	Rabi Bran & Grain	Rabi Oilseed Cake	Rabi Straw	Rabi Green Fodder	Rabi Grass
Rice	85.1	11.5	517.5	1,040.0	1,820.0
Sugarcane	433.1	21.8	2,312.0	2,345.9	4,105.3
Total	518.2	33.3	2,829.5	3,385.9	5,925.3

Source: See Table 20

Table 23

TOTAL NET AVAILABILITY OF FEED BY TYPE OF FEED 1987-1988
NWFP
('000)

Zone/Region	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Irrigated	(0.4)	1.7	1,129.3	1,819.7	4,549.2
Unirrigated	80.5	7.3	450.2	561.9	2,950.0
Total	80.1	9.0	1,579.5	2,381.6	7,499.2

Zone/Region	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Irrigated	40.0	1.0	647.3	947.1	2,367.6
Unirrigated	69.7	8.1	563.4	847.6	4,450.1
Total	109.8	9.1	1,210.7	1,794.7	6,817.7

Source: See Table 20

Table 24

TOTAL NET AVAILABILITY OF FEED BY TYPE OF FEED 1987-1988
BALOCHISTAN
(000 tonnes)

Zone/Region	Kharif: Bran & Grain	Kharif: Oilseed Cake	Kharif: Straw	Kharif: Green Fodder	Kharif: Grass
Kharif	40.9	0.7	381.2	83.8	440.2

Zone/Region	Rabi: Bran & Grain	Rabi: Oilseed Cake	Rabi: Straw	Rabi: Green Fodder	Rabi: Grass
Rabi	70.8	9.4	523.0	47.7	250.3

Source: See Table 20

cows. The ratios used to convert various animals into standard units are presented in Table 25. Here it is assumed that male need more feed than their females and young stock about half of a female animal in a given category [Sial et al].

II.3.8 Estimates of standard animals for each region/zone are presented in Tables 26 to 31. It may be noted that we have separated the milking animals from the non-milking ones. This is done to meet the requirements of the model where meat and fresh milk production are treated separately. Similarly it is to be kept in view that standard animal units under goats and sheep are not the actual heads of these animals. These standard units have also been presented separately to match with 'meat' and beef production and consumption figures in our model.

SECTION III. CALCULATING ALTERNATIVE RATIONS

The data on net feed availability and standard animal units enabled us to calculate feed rations as follows:

III.1 Ration I: It was assumed that 90% of the net availability of 'bran and grain' is fed to milking animals. The rest is allocated to non-milking animals and sheep and goats. As regards feed cakes, its 95% is assumed to go to milking animals and only 5% to non-milking ones. Sheep and goats are assumed not to consume any cake.[5]

With regard to straw, green fodder, and pasture, it was assumed that for maintenance of body weight, both milking and non-milking animals use these feeds in the same proportions. Milking animal however have to consume additional TDN and DP to produce milk.[6] As regards goats and sheep (as standard animals) it was assumed that they take relatively more grass than other animals.

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[5] These assumptions appear somewhat arbitrary but are not too off the mark. They were arrived at after discussion with experts at NARC.

[6] See Sial et.al [10] for this assumption. However the assumption that all animals (other than goats and sheep) have equal excess to straw, green and pasture is only a simplification. It is quite possible that non-milking animals are fed relatively more of pasture and straw and relatively less of cut green fodder.

Table 25

BASIS FOR CONVERTING LIVESTOCK HEAD INTO ANIMAL UNITS
****

Type of Livestock	Animal units
Cattle	
1 Adult cow	1.00
1 Adult bull	1.30
1 Youngstock	0.50
Buffaloes	
1 Adult buffalo cow	1.25
1 Adult buffalo bull	1.50
1 Youngstock	0.50
Sheep and goats	
5 Adult males	1.30
5 Adult females	1.00
5 Youngstock	0.50
Others	
1 Adult horse	1.30
1 Youngstock	0.75

Source: Adapted from Sial et al [10]

Table 26

DISTRIBUTION OF STANDARD ANIMAL UNITS BY ZONE
IN PAKISTAN, 1987 - 1988
****

(Percentage share)

Zone/Region	Milking Animal	Non-Milking Animals	Sheep and Goats
Pakistan	100.00%	100.00%	100.00%
Punjab	59.59	56.70	42.40
Rice	17.48	14.09	4.56
Sugarcane	10.35	9.14	6.57
Cotton	28.27	28.68	25.19
Barani	3.49	4.79	6.08
Sind	23.26	24.42	35.31
Rice	9.22	9.73	10.21
Cotton	14.04	14.69	25.10
NWFP	12.25	16.20	14.17
Irrigated	7.26	9.84	7.86
Unirrigated	4.99	6.36	6.31
Balochistan	4.90	2.67	8.13
Total Standard Animal. (000)	12000.92	19662.69	5763.93

Source: Estimates based on Tables 27 to 31.

Table 27

ANIMAL POPULATION CONVERTED INTO STANDARD ANIMAL UNITS, 1987-88
****
ALL PROVINCES

('000)

CROP ZONES	MILKING ANIMALS	NON-MILKING	SHEEP & GOAT	TOTAL
PUNJAB	7,150.47	11,147.94	2,443.42	20,741.82
SIND	2,790.60	4,801.52	2,035.22	9,627.35
NWFP	1,470.91	3,186.40	816.52	5,473.83
BALOCHISTAN	588.94	526.83	468.77	1,584.54
GRAND TOTAL	12,000.92	19,662.69	5,763.93	37,427.54

Source: Based on data from Tables 1 to 5 and Table 25

Table 28

ANIMAL POPULATION CONVERTED INTO STANDARD ANIMAL UNITS, 1987-88
****
PUNJAB

(,000)

CROP ZONES	MILKING ANIMALS	NON-MILKING	SHEEP & GOAT	TOTAL
RICE	2,097.51	2,770.19	262.62	5,130.32
SUGARCANE	1,241.98	1,797.61	378.77	3,418.36
COTTON	3,392.07	5,640.14	1,451.84	10,484.05
BARANI	418.90	940.00	350.19	1,709.09
TOTAL	7,150.47	11,147.94	2,443.42	20,741.82

Source: See Table 27

Table 29

ANIMAL POPULATION CONVERTED INTO STANDARD ANIMAL UNITS, 1987-88

SIND

('000)

CROP ZONES	MILKING ANIMALS	NON-MILKING	SHEEP & GOAT	TOTAL
RICE	1,106.24	1,913.93	588.40	3,608.58
COTTON	1,684.36	2,887.59	1,446.82	6,018.77
TOTAL	2,790.60	4,801.52	2,035.22	9,627.35

Source: See Table 27

Table 30

ANIMAL POPULATION CONVERTED INTO STANDARD ANIMAL UNITS, 1987-88

NWFP

('000)

CROP ZONES	MILKING ANIMALS	NON-MILKING	SHEEP & GOAT	TOTAL
NWFP IRRIGATED	871.78	1,935.07	452.80	3,259.65
NWFP UN-IRRIGATED	599.13	1,251.33	363.72	2,214.18
TOTAL	1,470.91	3,186.40	816.52	5,473.83

Source: See Table 27

Table 31

ANIMAL POPULATION CONVERTED INTO STANDARD ANIMAL UNITS, 1987-88

BALOCHISTAN

('000)

CROP ZONES	MILKING ANIMALS	NON-MILKING	SHEEP & GOAT	TOTAL
BALOCHISTAN	588.94	526.83	468.77	1,584.54

Source: See Table 27

III.2. Under the above stated assumptions:

Rations I For Milking Animals (MLK) is the combination of α_{1i} to α_{5i}

$$\alpha_{1i} = \lambda_1 \, BG_i/MLK_i \; \ldots\ldots\ldots\ldots\ldots\ldots(1)$$

$$\alpha_{2i} = \sum_{j=1}^{4} \lambda_2 \, CK_j / \sum_{j=1}^{4} MLK_j \; \ldots\ldots\ldots\ldots(2)$$

$$\alpha_{3i} = \lambda_3 \, STR_i/(MLK_i+NMLK_i) \; \ldots\ldots\ldots(3)$$

$$\alpha_{4i} = \lambda_4 \, GF_i/(MLK_i+NMLK_i) \; \ldots\ldots\ldots(4)$$

$$\alpha_{5i} = \lambda_5 \, GRS_i/(MLK_i+NMLK_i) \; \ldots\ldots\ldots(5)$$

Where α_{1i} to α_{5i} stand for per unit availability of different feeds to milking animals in ith zone; BG is for Bran and Grain produced in ith zone; CK; is cake produced in ith province; STR stands for Straw; GF stands for Green Fodder; GRS for Grass; and NMLK stands for non-milking animals; λ_1 to λ_2 are the proportion of total net feed in respective categories allocated to milking animals, whereas λ_3, λ_4 and λ_5 are the proportions of STR, GF and GRS allocated to milking and non-milking animals taken together[7]. Values of these proportions were taken to as follows:

$\lambda_1 = 0.90$; $\lambda_2 = 0.95$; $\lambda_3 = 0.97$; $\lambda_4 = 0.97$ and $\lambda_5 = 0.90$

---

7 Availability of BG can be assumed to be at the provincial level (instead of at the zonal level) because of its relatively easy mobility. For cake (CK) one can go even go to the extent that the zonal available is equal to the national average. Our first set of rations are therefore based on this assumption. However it is assumed that in cotton zone of Punjab and Sind feed cake made available is 20% more than the same in other zones. For straw, green fodder and grass, availability is restricted at the zonal level.

III.3 For non-milking animals, Ration I is also estimated similar to that for MLK. For this case it is taken as a combination of β_{1i} to β_{5i}.

$$\beta_{1i} = {}^{*}\lambda_1 \, BG_i/NMLK_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(6)$$

$$\beta_{2i} = \sum_{j=1}^{4} {}^{*}\lambda_2 \, CK_j / \sum_{j=1}^{4} MLK_j \quad \ldots\ldots\ldots\ldots\ldots(7)$$

$$\beta_{3i} = \alpha_{3i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(8)$$

$$\beta_{4i} = \alpha_{4i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(9)$$

$$\beta_{5i} = \alpha_{5i} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(10)$$

Here β_5 refers to rations for NMLK; and λ_1 and λ_1 are proportions of BG and CK respectively allocated to NMLK. The values of these proportions were:

${}^{*}\lambda_1 = 0.09$
${}^{*}\lambda_2 = 0.05$

Expressions 8 to 10 should be clear as we have assumed that the per unit quantities of these feeds consumed by both categories of animals are the same.

III.4. For sheep and goats (SG), Ration I is a combination of γ_{1i} to γ_{5i}, where:

$$\gamma_{1i} = (1 - \lambda_1 - {}^{*}\lambda_1)\,(BG_i)/SG_i \quad \ldots\ldots\ldots(11)$$

$$\gamma_{2i} = 0 \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(12)$$

$$\gamma_{3i} = (1 - \lambda_3)\,(STR_i)/SG_j \quad \ldots\ldots\ldots\ldots(13)$$

$$\gamma_{4i} = (1 - \lambda_4)\,(GF_i)/SG_i \quad \ldots\ldots\ldots\ldots(14)$$

$$\gamma_{5i} = (1 - \lambda_5)\,(GRS_i)/SG_i \quad \ldots\ldots\ldots\ldots(15)$$

Here γ_3 are per unit feeds of various categories available to sheep and goats taken together. All other expressions should be obvious if we keep in view the discussions preceding to equation 1 and the expressions relating to rations for MLK and NMLK.

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III.5. Poultry Rations

III.5.1. For poultry separate estimates of rations were required for commercial and non-commercial birds. Accordingly for broilers and layers Ration I was combination of C_{1i} to C_{5i}. Where

$$C_{1i} = PBG_i/COMB_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(16)$$

$$C_{2i} = \sum_{j=1}^{4} (0.02CK_j)/ \sum_{j=1}^{4} COMB_j \quad \ldots\ldots\ldots(17)$$

$$C_{3i} = FSHM_i/COMB_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(18)$$

$$C_{4i} = CHM_i/COMB_i \quad \ldots\ldots\ldots\ldots\ldots\ldots(19)$$

Where:	PBGi is the total bran and grain used by commercial poultry birds in ith zone;
COMBi =	Commercial poultry birds in ith zone;
FSHMi =	Total 'fish and other meals used by commercial birds in ith zone;
CHM =	Chemical and vitamins consumed by commercial poultry in ith zone, and
CKj =	Feed cake as described earlier. (only 2% of the total is allocated to poultry).

III.5.2 For non-commercial poultry, Ration I is based entirely on bran and grain as other categories of feed are rarely available to these birds. Even bran and grain fed to non-commercial birds is probably one-half of what is given to commercial birds. Accordingly Ration I for non-commercial birds (from BG) was assumed to be 50% of that given to commercial poultry.

III.6. Alternative Rations

III 6.1 Rations other than those based on the existing availability of feeds were calculated by assuming higher levels of livestock productivity. Accordingly Ration II was based on the assumption of 10% more productivity, whereas Ration III was based on 5% increase in livestock productivity associated with ration I. [See Table 36 for livestock yields associated with different rations]

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III 6.2 Increase in productivity can be achieved by increased availability of one or more than one feed. But from the policy point of view, perhaps it was more important to see whether increase in feed comes through increase in food grain crops or through increase in oilseeds production. Yet another choice could be to increase fodder production relative to other crops.

III.6.3 In the first stage of our analysis we would like to see the impact of increasing feed through food grain crops only. Accordingly for all categories of livestock other than poultry Rations II were estimated as follows:

Ration II: The amounts of bran and grain, and that of straw (as by-product of crops) in Ration I were increased by 10%. Other feed items were the same as in Ration I. The associated yields were increased by 10%;

Ration III: In this case, only the amounts of cake were increased by 10% whereas other components of feed in Ration I were not changed. (The associated increase in yields is only 5% because 10% increase in cake alone has much less TDN and DP values as compared to that of 10% increase in bran and grain and straw together).

SECTION IV ESTIMATES OF RATIONS

IV.1 Tables 32 to 35 show estimates of rations for livestocks in various zones. The productivity level associated with these ratios are presented in Table 36.

All these estimates are used in the first run of the model. On the basis of these figures, other values of rations can be generated to evaluate alterative policy options. Those values are available in the model but have not been presented here to keep this report to a manageable limit.

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Table 32

PUNJAB Kharif

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES, BY CROP-ZONE IN PUNJAB, 1987-88
****

KHARIF SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER	POULTRY (COMMERCIAL LAYER	POULTRY NON-COMMERCIAL)
RICE						
Bran & Grain	275.9	20.9	24.5	12.6	12.6	4.9
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	1023.8	1023.8	586.9	0.0	0.0	0.0
Green Fodder	694.8	694.8	398.3	0.0	0.0	0.0
Grazing	1066.6	1066.6	2196.7	0.0	0.0	0.0
SUGARCANE						
Bran & Grain	298.9	20.7	10.9	12.7	12.7	4.9
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	848.7	848.7	210.6	0.0	0.0	0.0
Green Fodder	1423.4	1423.4	353.3	0.0	0.0	0.0
Grazing	2196.6	2196.6	1958.6	0.0	0.0	0.0
COTTON						
Bran & Grain	526.7	31.7	13.7	12.6	12.6	4.9
Cake	205.3	6.1	0.0	0.5	0.5	0.0
Straw	957.7	957.7	184.3	0.0	0.0	0.0
Green Fodder	1064.7	1064.7	204.9	0.0	0.0	0.0
Grazing	1642.1	1642.1	1135.1	0.0	0.0	0.0
BARANI						
Bran & Grain	40.5	1.8	0.5	12.4	12.4	4.7
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	347.6	347.6	41.7	0.0	0.0	0.0
Green Fodder	169.9	169.9	20.4	0.0	0.0	0.0
Grazing	780.6	780.6	336.6	0.0	0.0	0.0
TOTAL PUNJAB						
Bran & Grain	385.1	24.7	12.5	12.6	12.6	4.9
Cake	187.3	6.1	0.0	0.5	0.5	0.0
Straw	911.9	911.9	211.2	0.0	0.0	0.0
Green Fodder	959.4	959.4	222.2	0.0	0.0	0.0
Grazing	1517.1	1517.1	1262.4	0.0	0.0	0.0

Source: Based on Tables 21 to 24 and Table 26

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Table 32 (Continued)

PUNJAB Rabi

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES, BY CROP-ZONE IN PUNJAB, 1987-88
****
RABI SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER)	POULTRY (COMMERCIAL LAYER)	POULTRY (NON-COMMERCIAL)
RICE						
Bran & Grain	275.9	20.9	24.5	12.6	12.6	4.9
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	1023.8	1023.8	586.9	0.0	0.0	0.0
Green Fodder	1670.4	1670.4	957.5	0.0	0.0	0.0
Grazing	2542.7	2542.7	5236.6	0.0	0.0	0.0
SUGARCANE						
Bran & Grain	298.9	20.7	10.9	12.7	12.7	4.9
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	848.7	848.7	210.6	0.0	0.0	0.0
Green Fodder	1887.3	1887.3	468.4	0.0	0.0	0.0
Grazing	2872.9	2872.9	2561.6	0.0	0.0	0.0
COTTON						
Bran & Grain	526.7	31.7	13.7	12.6	12.6	4.9
Cake	205.3	6.1	0.0	0.5	0.5	0.0
Straw	957.7	957.7	184.3	0.0	0.0	0.0
Green Fodder	1394.1	1394.1	268.2	0.0	0.0	0.0
Grazing	2122.1	2122.1	1466.9	0.0	0.0	0.0
BARANI						
Bran & Grain	40.5	1.8	0.5	12.4	12.4	4.7
Cake	171.0	6.1	0.0	0.5	0.5	0.0
Straw	347.6	347.6	41.7	0.0	0.0	0.0
Green Fodder	100.9	100.9	12.1	0.0	0.0	0.0
Grazing	461.0	461.0	198.8	0.0	0.0	0.0
TOTAL PUNJAB						
Bran & Grain	385.1	24.7	12.5	12.6	12.6	4.9
Cake	187.3	6.1	0.0	0.5	0.5	0.0
Straw	911.9	911.9	211.2	0.0	0.0	0.0
Green Fodder	1453.5	1453.5	336.6	0.0	0.0	0.0
Grazing	2235.3	2235.3	1860.0	0.0	0.0	0.0

Source: Based on data from Tables 21 to 24 and Table 26

Table 33 SIND (Kharif)

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES, BY CROP-ZONE IN SIND, 1987-88
****

KHARIF SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER	POULTRY (COMMERCIAL LAYER	POULTRY (NON-COMMERCIAL)
RICE						
Bran & Grain	239.46	13.84	5.00	10.43	10.43	4.90
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	987.80	987.80	156.81	0.00	0.00	0.00
Green Fodder	601.74	601.74	95.52	0.00	0.00	0.00
Grazing	1308.54	1308.54	746.28	0.00	0.00	0.00
COTTON						
Bran & Grain	340.30	19.85	4.40	10.47	10.47	4.89
Cake	205.26	6.10	0.00	0.54	0.54	0.00
Straw	672.48	672.48	65.72	0.00	0.00	0.00
Green Fodder	644.32	644.32	62.97	0.00	0.00	0.00
Grazing	1401.16	1401.16	491.96	0.00	0.00	0.00
TOTAL SIND						
Bran & Grain	300.32	17.45	4.58	10.45	10.45	4.89
Cake	191.70	6.10	0.00	0.54	0.54	0.00
Straw	797.91	797.91	92.06	0.00	0.00	0.00
Green Fodder	627.38	627.38	72.38	0.00	0.00	0.00
Grazing	1364.31	1364.31	565.49	0.00	0.00	0.00

Source: See Table 32

SIND (Rabi)

RABI SEASON (RATION1)

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER	POULTRY (COMMERCIAL LAYER	POULTRY (NON-COMMERCIAL)
RICE						
Bran & Grain	239.46	13.84	5.00	10.43	10.43	4.90
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	987.80	987.80	156.81	0.00	0.00	0.00
Green Fodder	334.02	334.02	53.02	0.00	0.00	0.00
Grazing	508.45	508.45	289.98	0.00	0.00	0.00
COTTON						
Bran & Grain	340.30	19.85	4.40	10.47	10.47	4.89
Cake	205.26	6.10	0.00	0.54	0.54	0.00
Straw	672.48	672.48	65.72	0.00	0.00	0.00
Green Fodder	497.71	497.71	48.64	0.00	0.00	0.00
Grazing	757.63	757.63	266.01	0.00	0.00	0.00
TOTAL SIND						
Bran & Grain	300.32	17.45	4.58	10.45	10.45	4.89
Cake	191.70	6.10	0.00	0.54	0.54	0.00
Straw	797.91	797.91	92.06	0.00	0.00	0.00
Green Fodder	432.59	432.59	49.91	0.00	0.00	0.00
Grazing	658.50	658.50	272.94	0.00	0.00	0.00

Source: See Table 32

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Table 34

NWFP Kharif

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES, BY CROP-ZONE IN NWFP, 1987-88
****

KHARIF SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL) BROILER	POULTRY (COMMERCIAL) LAYER	POULTRY (NON-COMMERCIAL)
IRRIGATED						
Bran & Grain	40.92	1.84	0.88	13.54	13.54	4.88
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	613.98	613.98	117.71	0.00	0.00	0.00
Green Fodder	628.86	628.86	120.56	0.00	0.00	0.00
Grazing	1368.01	1368.01	942.23	0.00	0.00	0.00
NON-IRRIGATED						
Bran & Grain	225.69	10.81	4.13	13.60	13.60	4.99
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	531.33	531.33	83.60	0.00	0.00	0.00
Green Fodder	294.55	294.55	46.35	0.00	0.00	0.00
Grazing	1345.10	1345.10	760.37	0.00	0.00	0.00
TOTAL NWFP						
Bran & Grain	116.18	5.36	2.33	13.56	13.56	4.90
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	581.14	581.14	102.52	0.00	0.00	0.00
Green Fodder	496.03	496.03	87.50	0.00	0.00	0.00
Grazing	1358.91	1358.91	861.22	0.00	0.00	0.00

Source: See Table 32

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Table 34 (Continued)

NWFP Rabi

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES, BY CROP-ZONE IN NWFP, 1987-88
****

RABI SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	(POULTRY COMMERCIAL BROILER	LAYER	NON-COMMERCIAL)
IRRIGATED						
Bran & Grain	40.92	1.84	0.88	13.54	13.54	4.88
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	613.98	613.98	117.71	0.00	0.00	0.00
Green Fodder	327.29	327.29	62.75	0.00	0.00	0.00
Grazing	711.72	711.72	490.20	0.00	0.00	0.00
NON-IRRIGATED						
Bran & Grain	225.69	10.81	4.13	13.60	13.60	4.99
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	531.33	531.33	83.60	0.00	0.00	0.00
Green Fodder	444.32	444.32	69.91	0.00	0.00	0.00
Grazing	1932.47	1932.47	1092.40	0.00	0.00	0.00
TOTAL NWFP						
Bran & Grain	116.18	5.36	2.33	13.56	13.56	4.90
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	581.14	581.14	102.52	0.00	0.00	0.00
Green Fodder	373.79	373.79	65.94	0.00	0.00	0.00
Grazing	1196.75	1196.75	758.45	0.00	0.00	0.00

Source: See Table 32

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Table 35

BALUCHISTAN Kharif

ANNUAL AVAILABLE RATION (KG) PER UNIT OF STANDARD ANIMAL (RATION1)
FOR DIFFERENT LIVESTOCK CATEGORIES BY CROP-ZONE, BALUCHISTAN, 1987-88.
****

KHARIF SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER	POULTRY (COMMERCIAL LAYER	POULTRY (NON-COMMERCIAL)
BALUCHISTAN						
Bran & Grain	170.67	19.08	2.38	10.13	10.13	5.00
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	786.02	786.02	57.86	0.00	0.00	0.00
Green Fodder	72.89	72.89	5.37	0.00	0.00	0.00
Grazing	335.05	335.05	88.61	0.00	0.00	0.00

Source: See Table 32

BALUCHISTAN Rabi

RABI SEASON

CROP ZONE/ RATION CATEGORY	MILKING	NON-MILKING	SHEEP & GOAT	POULTRY (COMMERCIAL BROILER	POULTRY (COMMERCIAL LAYER	POULTRY (NON-COMMERCIAL)
BALUCHISTAN						
Bran & Grain	170.67	19.08	2.38	10.13	10.13	5.00
Cake	171.05	6.10	0.00	0.54	0.54	0.00
Straw	786.02	786.02	57.86	0.00	0.00	0.00
Green Fodder	41.45	41.45	3.05	0.00	0.00	0.00
Grazing	189.27	189.27	50.06	0.00	0.00	0.00

Source: See Table 31

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Table 36

YIELD LEVELS ASSOCIATED WITH DIFFERENT RATIONS FOR SELECTED LIVESTOCKS, PAKISTAN, 1987-88*

NEW RATIONS	(YIELD PER STANDARD ANIMAL) (PER YEAR)			COMMERCIAL POULTRY			NON-COMMERCIAL POULTRY	
	MILK (LITRE)	BEEF (KG)	MUTTON (KG)	BROILER MEAT (Kg/Bird)	LAYER MEAT	EGGS (Nos.)	MEAT (KG) (Kg/Bird)	EGGS (Nos.)
Ration I (Based on Availability of Feed)	1075	167	164	0.909	1.364	133	1.136	89
Ration II (10% more of Bran and Grain and Straw)	1183	183.7	180.4	0.909	1.364	133	1.136	89
Ration III (10% more of Cake only)	1129	175.4	172.2	1.092	1.638	160	1.136	89
Ration IV (Relevant to Poultry only)	NA	NA	NA	0.909	1.364	133	1.136	89

*YIELD FOR MILK, BEEF AND MUTTON IS INCREASED BY 10% IN RATION III.

SOURCE: YIELD UNDER RATION I WERE CALCULATED ON THE BASIS OF DATA TAKEN FROM THE AGRICULTURAL STATISTICS OF PAKISTAN, 1988-89.

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ANNEX VI

A DESCRIPTION OF PASM EQUATIONS (ROWS) AND ACTIVITIES (COLUMNS)

The annex describes the indicators in the variable names, i.e., what information is contained in the rather complex names ascribed to the rows of the model. With practice the user of the model should be able to read the names and understand the nature of the equation quickly. It will take some patience at first. In the immediately following section each group of equations is discussed. Afterwards, the entire set of equations are presented, with definitions of and units for each equation. The same presentation is made subsequently for all columns in the model.

A6.1 A Description of the Equations (Rows) in the Model

National Domestic Consumption. (Rows 1-18). In the first three positions all rows are labelled NDC, indicating a national domestic consumption supply-demand balance row. The final three positions in the name indicate the commodity which is being modelled. The symbols and commodities are: RIB, Basmati Rice ; RIO, Other Rice; COG, Coarse Grains; CTF, Cotton Fiber; SUG, Sugar; PUL, Pulses; VEG, Vegetables; WHE, Wheat and Wheat Products; FRU, Fruit; VGE, Vegetable Ghee; LOI, Liquid Oils (Mustard, Sunflower and Safflower Oil); BEE, Bee; MIL, Milk; BUT, Butter; AGE, Animal Ghee (Desi); MUT, Mutton; POU, Poultry Meat; EGG, Eggs.

National Processing of Vegetable Ghee. (Rows 19-20). The PRO in the first three letters indicates that these are processing equations. The last three positions indicate the commodity, either SOY for soybean oil or PAL for palm oil.

Export and Import Balances. (Rows 21-31). The first three positions are either EXB or IMB, indicating that the equation is an Import or Export Balance equation. The last three or four positions indicate the commodity being exported or imported. They are usually the same symbol as for domestic demand, although there are several changes: RIE, Export of Basmati Rice; RIO, Export of Other Rice; CTF, Export of Cotton Fiber; VEG, Export of Vegetables; FRU, Export of Fruit; SUG, Import of Sugar; PUL, Import of Pulses; WHE, Import of Wheat and Wheat Products; SOYO, Import of Soybean Oil; PALO, Import of Palm Oil; MIL, Import of Milk

Farm Income Accounting Row. (Row 32). FARMINC tabulates the net farm income from a given simulation.

Convex Combination Constraints. (Rows 33-51). These equations restrict the points on the demand curves in the solution to be adjacent to each other and are part of the demand specification. The CCC at the front of the name indicates the type of equation; the last three positions indicate the commodity, which are the same as the commodities listed in the final demand discussion.

Punjab Region

Punjab Region Equations. (Rows 52-242). The equations describing the Punjab region are first distinguished by whether they refer to regional or zonal equations. The first two letters in the name will be PU if referring to an equation specified at the regional level. Otherwise they will refer to a zonal equation and be PR, for Punjab Rice Zone, PS for the Sugarcane zone, and PC for the Cotton Zone. The equations are discussed below in the order they appear in the model.

Production Equations. (Rows 52-68). After the PU designation indicating they are for the region, production equations have a "P" in the third position, and then the commodity designation follows in the last three positions. The latter include: RIB, Rice Basmati; RIO, Other Rice; COG, Coarse Grains; CTF, Cotton Fiber; SUG, Sugarcane; TOL, Traditional Oilseed; NOK, Non-traditional Oilseeds, Kharif; PUL, Pulses; HVA, Vegetables; WHE, Wheat; NOR, Non-traditional Oilseeds, Rabi; FRU, Fruit; MCA, Milking Cows; NMC, Non-Milking Cows; GOS, Goats and Sheep; POU, Poultry; EGG, Egg.

Input Balances. (Rows 69-73). These are regional equations, so that the first letters are PU. They are followed by an "I" for input balances, and then by the designation of the input: FEN, Nitrogen Fertilizer; FEP, Phosphorus Fertilizer; FEK, Potash Fertilizer; HL, Hired Labor; TTR, Total Tractor Services.

Regional Resource Restrictions. (Rows 74-77). The equations contain the PU designation as they are regional, and the last three letters are for the type of input and season. So "HLK" is hired labor, kharif and "HLR" is Hired Labor, Rabi. The PLU indicates a Limit on a Punjab resource.

Farm Level Resource Restrictions (Rows 78-98, 133-153, 188-208). The equations for the farm level all begin with the PR, PS, or PC designation showing which zone they are in. In the third position is a S, M, or L referring to the size of farm: Small, Medium or Large. The fourth position contains an "R", to shows that the equation is a resource restriction. The final equations indicate the type of equation being considered: FALK, a restriction on Family Labor in Kharif; LAK, a restriction on land in Kharif; FALR, a restriction on Family Labor in Rabi; LAR, a restriction on land in Rabi; ROBCW, Rotation constraints on the planting of basmati or Cotton in Kharif and Wheat in Rabi; MKTSW, a market surplus function for wheat; and MKTSR, a market surplus function for rice. The last three names do not include an "R" in the fourth position because they would exceed the eight character limit (in LINDO).

Zonal Resource Restrictions. (Rows 99-119, 152-172, 209-229). The zonal resource restriction include the zonal designation (PR, PS, PC) and an R in the third position indicating that it is a restriction equation. (There is also, in some equations, an L in the second position indicating that the equation is a Limit equation. In this case, PLS would indicate a limit equation in the Punjab Sugarcane zone). The remaining letters indicate the resource being constrained or limited. They include: FEKK, Potash Fertilizer, Kharif; FENK, Nitrogen Fertilizer, Kharif; FEPK, Phosphorus Fertilizer, Kharif; BULK Bullock Availability, Kharif; BULR, Bullock Labor, Rabi; FYM, Farm Yard Manure; TOWK, Total Water Requirements, Kharif; TOWR, Total Water Requirements, Rabi; CAWK, Limits on Canal Water, Kharif; CAWR, Limits on Canal Water, Rabi; TUWK, Limits on Tubewell Water, Kharif; TUWR, Limits on Tubewell Water, Rabi.

Zonal Livestock Feed Rations. (Rows 120-126, 175-181, 230-236). The first two letters refer to the zone and the third letter is an F, indicating that the name refers to a feed

ration. The remaining letters indicate the type of feed being modelled. They include: FEED, Feed; CAKE, Oilseed Feedcake; STRAW, Straw; GREK, Green, Kharif; GRER, Green Rabi; PAST, Pasture; FISHM, Fishmeal

Zonal Livestock Herd Levels. (Rows 127-132, 182-187, 237-242). The first two letters for these equations are the zonal designation (PR, PS, or PC) and the next two letters are HL, showing the type of equation. The remaining letters refer to the type of livestock being modelled by the equation. They include: MCA, Milking Cows and Buffaloes; NMCA, Non-Milking Cows and Buffaloes; GOSH, Goats and Sheep providing Mutton; BRO, Broilers; LAY, Layers; DESI, Desi Chickens.

Sind Region

Sind Region Equations. (Rows 243-377). The equations describing the Sind region are first distinguished by whether they refer to regional or zonal equations. The first two letters in the name will be SI if referring to an equation specified at the regional level. Otherwise they will refer to a zonal equation and be SR, for Sind Rice Zone or SC for the Cotton Zone. The equations are in the order they appear in the model.

Production Equations. (Rows 243-258). After the SI designation indicating they are for the region, production equations have a "P" in the third position, and then the commodity designation follows in the last three positions. The latter include: RIO, Other Rice; COG, Coarse Grains; CTF, Cotton Fiber; SUG, Sugarcane; TOL, Traditional Oilseed; NOK, Non-traditional Oilseeds, Kharif; PUL, Pulses; HVA, Vegetables; WHE, Wheat; NOR, Non-traditional Oilseeds, Rabi; FRU, Fruit; MCA, Milking Cows; NMC, Non-Milking Cows; GOS, Goats and Sheep; POU, Poultry; EGG, Egg. Basmati rice is not produced in the Sind and is therefore not in the list.

Input Balances. (Rows 259-263). These are regional equations, so that the first letters are SI. They are followed by an "I" for input balances, and then by the designation of the input: FEN, Nitrogen Fertilizer; FEP, Phosphorus Fertilizer; FEK, Potash Fertilizer; HL, Hired Labor; TTR, Total Tractor Services.

Regional Resources Restrictions. (Rows 264-267). The equations contain the SI designations as they are regional, and the last three letters are for the type of input and season. So "HLK" is hired labor, kharif, and "HLR" is Hired Labor, Rabi. The SLI indicates a Limit on a Sind resource.

Farm Level Resource Restrictions (Rows 268-288, 323-343). The equations for the farm level all begin with the SR or SC designation showing which zone they are in. In the third position is a S, M, or L, referring to the size of farm: Small, Medium or Large. The fourth position contains an R, to show that the equation is a resource restriction. The final letters indicate the type of equation being considered: FALK, a restriction on Family Labor

in Kharif; LAK, a restriction on land in Kharif; FALR, a restriction on Family Labor in Rabi; LAR, a restriction on land in Rabi; ROBCW, Rotation constraints on the planting of basmati or Cotton in Kharif and Wheat in Rabi; MKTSW, a market surplus function for wheat; and MKTSR, a market surplus function for rice. The last three names do not include an "R" in the fourth position because they would exceed the eight character limit (in LINDO).

Zonal Resource Restrictions. (Rows 99-119, 152-172, 209-229). The zonal resource restriction include the zonal designation (SR, SC) and an R in the third position indicating that it is a restriction equation. (There is also, in some equations, an L in the second position indicating that the equation is a Limit equation. In this case, SLR would indicate a limit equation in the Sind Rice zone). The remaining letters indicate the resource being constrained or limited. They include: FEKK, Potash Fertilizer, Kharif; FENK, Nitrogen Fertilizer, Kharif; FEPK, Phosphorus Fertilizer, Kharif; BULK, Bullock Availability, Kharif; BULR, Bullock Labor, Rabi; FYM, Farm Yard Manure; TOWK, Total Water Requirements, Kharif; TOWR, Total Water Requirements, Rabi; CAWK, Limits on Canal Water, Kharif; CAWR, Limits on Canal Water, Rabi; TUWK, Limits on Tubewell Water, Kharif; TUWR, Limits on Tubewell Water, Rabi.

Zonal Livestock Feed Rations. (Rows 310-316, 365-371). The first two letters refer to the zone and the third letter is an F, indicating that the name refers to a feed ration. The remaining letters indicate the type of feed being modelled. They include: FEED, Feed; CAKE, Oilseed Feedcake; STRAW, Straw; GREK, Green, Kharif; GRER, Green Rabi; PAST, Pasture; FISHM, Fishmeal.

Zonal Livestock Herd Levels. (Rows 317-322, 372-377). The first two letters for these equations are the zonal designation (SR or SC) and the next two letters are HL, showing the type of equation. The remaining letters refer to the type of livestock being modelled by the equation. They include: MCA, Milking Cows and Buffaloes; NMCA, Non-Milking Cows and Buffaloes; GOSH, Goats and Sheep providing Mutton; BRO, Broilers; LAY, Layers; DESI, Desi Chickens.

Baluchistan Region

Baluchistan Region Equations. (Rows 378-455). As there is only one zone in Baluchistan, the equations describing that region are only distinguished by a "BA", which refers to regional equations (but also to a zonal equation in Zone 6). The equations are presented in the following discussion as they appear in the model.

Production Equations. (Rows 378-391). After the BA designation indicating they are for the region, production equations have a "P" in the third position, and then the commodity designation follows in the last three positions: RIB, Rice Basmati; RIO, Other Rice; COG, Coarse Grains; SUG, Sugarcane; TOL, Traditional Oilseed; PUL, Pulses; VEG,

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Vegetables; WHE, Wheat; FRU, Fruit; MCA, Milking Cows; NMC, Non-Milking Cows; GOS, Goats and Sheep; POU, Poultry; EGG, Egg. There are no Cotton or Non-traditional oilseeds found in Baluchistan.

Input Balances. (Rows 392-396). These are regional equations, so that the first letters are BA. They are followed by an "I" for input balances, and then by the designation of the input: FEN, Nitrogen Fertilizer; FEP, Phosphorus Fertilizer; FEK, Potash Fertilizer; HL, Hired Labor; TTR, Total Tractor Services.

Regional Resource Restrictions. (Rows 397-421). The equations contain the BA designation as they are regional, and the last three letters are for the type of input and season. So "HLK" is hired labor, kharif. The BLA indicates a Limit on a Baluchistan resource. What are zonal restrictions in the Punjab and Sind are regional resource restrictions in Baluchistan, so that in addition to hired labor, fertilizer, bullock labor, farmyard manure and water are also included in this set of restrictions. Specifically the restrictions included are: FEKK, Potash Fertilizer, Kharif; FENK, Nitrogen Fertilizer, Kharif; FEPK, Phosphorus Fertilizer, Kharif; BULK, Bullock Availability, Kharif; BULR, Bullock Labor, Rabi; FYM, Farm Yard Manure; TOWK, Total Water Requirements, Kharif; TOWR, Total Water Requirements, Rabi; CAWK, Limits on Canal Water, Kharif; CAWR, Limits on Canal Water, Rabi; TUWK, Limits on Tubewell Water, Kharif; TUWR, Limits on Tubewell Water, Rabi; HLK, Hired Labor, Kharif; HLR, Hired Labor, Rabi.

Farm level Resource Restrictions (Rows 422-442). The equations for the farm level all begin with BA because there is only one zone in the region. In the third position is a S, M, or L referring to the size of farm: Small, Medium or Large. The fourth position contains an "R", to show that the equation is a resource restriction. The final equations indicate the type of equation being considered: FALK, a restriction on Family Labor in Kharif; LAK, a restriction on land in Kharif; FALR, a restriction on Family Labor in Rabi; LAR, a restriction on land in Rabi; ROBCW, Rotation constraints on the planting of basmati or Cotton in Kharif and Wheat in Rabi; MKTSW, a market surplus function for wheat; and MKTSR, a market surplus function for rice. The last three names do not include an "R" in the fourth position because they would exceed the eight character limit (in LINDO).

Regional Livestock Feed Rations. (Rows 443-449). The first two letters are BA to refer to the region and the third letter is an F, indicating that the name refers to a feed ration. The remaining letters indicate the type of feed being supplied and demanded. They include: FEED, Feed; CAKE, Oilseed Feedcake; STRAW, Straw; GREK, Green, Kharif; GRER, Green Rabi; PAST, Pasture; FISHM, Fishmeal.

Regional Livestock Herd Levels. (Rows 450-455). The first two letters for these equations are the regional designation, BA, and the next two letters are HL, showing the type of equation -- a Herd Level Equation. The remaining letters refer to the type of livestock being modelled by the equation. They include: MCA, Milking Cows and

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Buffaloes; NMCA, Non-Milking Cows and Buffaloes; GOSH, Goats and Sheep providing Mutton; BRO, Broilers; LAY, Layers; DESI, Desi Chickens.

NWFP Region

NWFP Region Equations. (Rows 456-536). Like Baluchistan, there is only one zone in NWFP, and the equations describing that region are all distinguished by a "NP" as the first two letters of the name, which refers to regional equations (but also to zonal equations of Zone 7). The equations are presented in the following discussion as they appear in the model.

Production Equations. (Rows 456-472). After the NP designation indicating they are for the region, production equations have a "P" in the third position, and then the commodity designation follows in the last three positions: RIB, Rice Basmati; RIO, Other Rice; COG, Coarse Grains; SUG, Sugarcane; TOL, Traditional Oilseed; PUL, Pulses; VEG, Vegetables; WHE, Wheat; FRU, Fruit; MCA, Milking Cows; NMC, Non-Milking Cows; GOS, Goats and Sheep; POU, Poultry; EGG, Egg. Thus, NWFP can produce the full range of products.

Input Balances. (Rows 473-477). These are regional equations, so that the first letters are NP. They are followed by an "I" for input balances, and then by the designation of the input: FEN, Nitrogen Fertilizer; FEP, Phosphorus Fertilizer; FEK, Potash Fertilizer; HL, Hired Labor; TTR, Total Tractor Services.

Regional Resource Restrictions. (Rows 478-502). The equations contain the NP designation as they are regional, and the last three letters are for the type of input and season. So "HLK" is hired labor, kharif. The BLA indicates a Limit on a NWFP resource. What are zonal restrictions in the Punjab and Sind are regional resource restrictions in NWFP, so that in addition to hired labor, fertilizer, bullock labor, farmyard manure and water are also included in this set of restrictions. Specifically the restrictions included are: FEKK, Potash Fertilizer, Kharif; FENK, Nitrogen Fertilizer, Kharif; FEPK, Phosphorus Fertilizer, Kharif; BULK, Bullock Availability, Kharif; BULR, Bullock Labor, Rabi; FYM, Farm Yard Manure; TOWK, Total Water Requirements, Kharif; TOWR, Total Water Requirements, Rabi; CAWK, Limits on Canal Water, Kharif; CAWR, Limits on Canal Water, Rabi; TUWK, Limits on Tubewell Water, Kharif; TUWR, Limits on Tubewell Water, Rabi; HLK, Hired Labor, Kharif; HLR, Hired Labor, Rabi.

Farm level Resource Restrictions (Rows 503-523). The equations for the farm level all begin with NP because there is only one zone in the region. In the third position is a S, M, or L referring to the size of farm: Small, Medium or Large. The fourth position contains an "R", to show that the equation is a resource restriction. The final equations indicate the type of equation being considered: FALK, a restriction on Family Labor in Kharif; LAK, a restriction on land in Kharif; FALR, a restriction on Family Labor in Rabi; LAR, a restriction on land in Rabi; ROBCW, Rotation constraints on the planting of

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basmati or Cotton in Kharif and Wheat in Rabi; MKTSW, a market surplus function for wheat; and MKTSR, a market surplus function for rice. The last three names do not include an "R" in the fourth position because they would exceed the eight character limit (in LINDO).

Regional Livestock Feed Rations. (Rows 524-530). The first two letters are NP to refer to the region and the third letter is an F, indicating that the name refers to a feed ration. The remaining letters indicate the type of feed being supplied and demanded. They include: FEED, Feed; CAKE, Oilseed Feedcake; STRAW, Straw; GREK, Green, Kharif; GRER, Green Rabi; PAST, Pasture; FISHM, Fishmeal.

Regional Livestock Herd Levels. (Rows 531-536). The first two letters for these equations are the regional designation, NP, and the next two letters are HL, showing the type of equation. The remaining letters refer to the type of livestock being modelled by the equation. They include: MCA, Milking Cows and Buffaloes; NMCA, Non-Milking Cows and Buffaloes; GOSH, Goats and Sheep providing Mutton; BRO, Broilers; LAY, Layers; DESI, Desi Chickens.

National Oilseed Processing Rows. (Rows 537-541). The oilseed complex uses three broadly different types of oilseeds: cottonseed, traditional oilseeds, and non-traditional oilseeds. Cottonseed is not marketed through normal channels, which are for cotton fiber only. Cottonseed is "collected" in the equation NAPCTS, the national procurement of cottonseed and is then moved into processing activities. The latter two oilssed types are marketed through normal channels but rather than going to final consumption, they go through intermediate processing activities. The rows which process each oilseed are: NIOTOL, National Processing of Traditional Oilseeds; NIONOL, National Processing of Non-Traditional Oilseeds; and NIOCTS, National Processing of Cottonseed. The final equation in this group, NSELCAK, transfers oilseed cake back to the ration equations in each zone.

Limits on Imports and Exports. (Rows 542-552). All imports and exports are limited in quantities. The equations which impose these limits all begin with an "EXL" for export limits or an "IML" for import limits. The last three or four letters in the name refer to the commodity: RIB, Basmati Rice; RIO, Other Rice; CTF, Cotton Fiber; VEG, Vegetables; FRU, Fruits; SUG, Sugar; PUL, Pulses; WHE, Wheat and Wheat Products; SOYO, Soybean Oil; PALO, Palm Oil; MIL, Milk. The first five are exported products and the last six are imported. No commodity is imported and exported.

Selected Limits on Acreages in Production. (Rows 553-558). The final equations in the model restrict various acreages to specific levels. All of these equations begin with a "LIM" indicating a limit equation. The remaining three letters refer to the types of activities being restricted: TOK, Traditional Oilseeds, Kharif; NOK, Non-traditional Oilseeds, Kharif;

TOR, Traditional Oilseeds, Rabi; NOR, Non-traditional Oilseeds, Rabi; PUL, Pulses, Kharif; FOK, Fodder, Kharif.

UNITS FOR ROWS IN PASM

Type of Row	Units
National Domestic Consumption	Metric Tons at Retail Level, Except Eggs, Millions of Eggs
National Processing of Vegetable Ghee	Metric Tons at Import Level
Export and Import Balances	Metric Tons. Milk Products in Raw Milk Equivalents.
Farm Income Accounting Row	Billions of Rupees.
Convex Combination Constraints	No Units.
Production Equations	Metric Tons at Farm Level, Except Eggs, Millions of Eggs at Farm Level
Input Balances and Regional Resource Restrictions	Fertilizer, Nutrient Tons; Hired Labor, '000 of Man-Hours; Tractor Services, '000 of Service Hours
Farm Level Resource Restrictions	Land, '000 of Hectares; Family labor, '000 of Man-hours; Rotation Limits, '000 of Hectares; Market Surplus Functions, Metric Tons at Farm Level
Zonal Resource Restrictions	Fertilizer, Nutrient Tons; Bullock Labor, '000 of Hours; Farm Yard Manure, Metric Tons; All Water, '000 of Acre Feet
Zonal Livestock Feed Rations	Metric Tons at Farm Level, Except Cake, which is processed Metric Tons.
Zonal Livestock Herd Levels	'000 of Standard Animal Units
National Oilseed Processing Rows	Metric Tons of Oilseed, Except NSELCAK, Metric Tons of Cake
Limits on Imports and Exports	Metric Tons at Imp/Exp Level
Limits on Acreages	'000 of Hectares

Row	Name	Description
		NATIONAL DOMESTIC CONSUMPTION
		(Supply and Demand Balance Rows)
1	NDCRIB	National Demand for Basmati Rice
2	NDCRIO	National Demand for Rice Other and Flour
3	NDCCOG	National Demand for Coarse Grains
4	NDCCTF	National Demand for Cotton Fiber
5	NDCSUG	National Demand for Sugar
6	NDCPUL	National Demand for Pulses
7	NDCVEG	National Demand for Vegetables
8	NDCWHE	National Demand for Wheat and Wheat Products
9	NDCFRU	National Demand for Fruits
10	NDCVGE	National Demand for Vegetable Ghee
11	NDCLOI	National Demand for Liquid Oils (Mustard, Sunflower and Safflower Oil)
12	NDCBEE	National Demand for Beef
13	NDCMIL	National Demand for Milk
14	NDCBUT	National Demand for Butter
15	NDCAGE	National Demand for Animal Ghee (Desi)
16	NDCMUT	National Demand for Mutton
17	NDCPOU	National Demand for Poultry Meat
18	NDCEGG	National Demand for Eggs
		NATIONAL PROCESSING OF VEGETABLE GHEE
		(Supply and Demand Balance Rows)
19	PROSOY	National Processing of Soybean Oil
20	PROPAL	National Processing of Palm Oil
		EXPORT AND IMPORT BALANCES
		(Supply and Demand Balance Rows)
21	NDCRIE	Export Balance of Basmati Rice
22	EXBRIO	Export Balance of Rice Other and Flour
23	EXBCTF	Export Balance of Cotton Fiber
24	EXBVEG	Export Balance of Vegetables
25	EXBFRU	Export Balance of Fruits
26	IMBSUG	Import Balance of Sugar
27	IMBPUL	Import Balance of Pulses
28	IMBWHE	Import Balance of Wheat and Wheat Products
29	IMBSOYO	Import Balance of Soybean Oil
30	IMBPALO	Import Balance of Palm Oil
31	IMBMIL	Import Balance of Milk
32	FARMINC	**Farm Income Accounting Row**
		CONVEX COMBINATION CONSTRAINTS
33	CCCRIE	Demand Constraints on Basmati Rice Exports
34	CCCRIB	Demand Constraints on Basmati Rice and Products
35	CCCRIO	Demand Constraints on Rice Other and Flour
36	CCCCOG	Demand Constraints on Coarse Grains
37	CCCCTF	Demand Constraints on Cotton Fiber
38	CCCSUG	Demand Constraints on Sugar
39	CCCPUL	Demand Constraints on Pulses

Row	Name	Description
40	CCCVEG	Demand Constraints on Vegetables
41	CCCFRU	Demand Constraints on Fruits
42	CCCWHE	Demand Constraints on Wheat and Wheat Products
43	CCCVGE	Demand Constraints on Vegetable Ghee
44	CCCLOI	Demand Constraints on Liquid Oils (Mustard, Sunflower and Safflower Oil)
45	CCCBEE	Demand Constraints on Beef
46	CCCMIL	Demand Constraints on Milk
47	CCCMUT	Demand Constraints on Mutton
48	CCCAGE	Demand Constraints on Animal Ghee (Desi)
49	CCCBUT	Demand Constraints on Butter
50	CCCPOU	Demand Constraints on Poultry Meat
51	CCCEGG	Demand Constraints on Eggs

PUNJAB REGION

PUNJAB PRODUCTION ROWS
(Supply and Demand Balance Rows)

52	PUPRIB	Production of Rice Basmati
53	PUPRIO	Production of Rice (other)
54	PUPCOG	Production of Coarse Grains
55	PUPCOT	Production of Cotton
56	PUPSUG	Production of Sugarcane
57	PUPTOL	Production of Traditional Oilseed
58	PUPNOK	Production of Non-traditional Oilseeds, Kharif
59	PUPPUL	Production of Pulses
60	PUPHVA	Production of High Value Products
61	PUPWHE	Production of Wheat
62	PUPNOR	Production of Non-traditional Oilseeds, Rabi
63	PUPFRU	Production of Fruit
64	PUPMCA	Production of Milking Cows
65	PUPNMC	Production of Non-Milking Cows
66	PUPGOS	Production of Goats and Sheep
67	PUPPOU	Production of Poultry
68	PUPEGG	Production of Eggs

PUNJAB INPUT BALANCES

69	PUIFEN	Input Balance for Fertilizer Nitrogen
70	PUIFEP	Input Balance for Fertilizer Phosphorus
71	PUIFEK	Input Balance for Fertilizer Potash
72	PUIHL	Input Balance for Hired Labor
73	PUITTR	Input Balance for Total Tractors

PUNJAB REGIONAL RESOURCE RESTRICTIONS

74	PURHLK	Demand for Hired Labor, Kharif
75	PURHLR	Demand for Hired Labor, Rabi
76	PLUHLK	Limits on Hired Labor, Kharif
77	PLUHLR	Limits on Hired Labor, Rabi

PUNJAB RICE ZONE
SMALL FARM RESOURCE RESTRICTIONS

78	PRSRFALK	Family Labor inc. ploughing, Kharif
79	PRSRLAK	Land Availability, Kharif
80	PRSRFALR	Family Labor inc. ploughing, Rabi
81	PRSRLAR	Land Availability, Rabi

Row	Name	Description
82	PRSROBCW	Rotation Limits for Basmati, Cotton and Wheat
83	PRSMKTSW	Market Surplus Function for Wheat
84	PRSMKTSR	Market Surplus Function for Rice
		PUNJAB RICE ZONE
		MEDIUM FARM RESOURCE RESTRICTIONS
85	PRMRFALK	Family Labor inc. ploughing, Kharif
86	PRMRLAK	Land Availability, Kharif
87	PRMRFALR	Family Labor inc. ploughing, Rabi
88	PRMRLAR	Land Availability, Rabi
89	PRMROBCW	Rotation Limits for Basmati, Cotton and Wheat
90	PRMMKTSW	Market Surplus Function for Wheat
91	PRMMKTSR	Market Surplus Function for Rice
		PUNJAB RICE ZONE
		LARGE FARM RESOURCE RESTRICTIONS
92	PRLRFALK	Family Labor inc. ploughing, Kharif
93	PRLRLAK	Land Availability, Kharif
94	PRLRFALR	Family Labor inc. ploughing, Rabi
95	PRLRLAR	Land Availability, Rabi
96	PRLROBCW	Rotation Limits for Basmati, Cotton and Wheat
97	PRLMKTSW	Market Surplus Function for Wheat
98	PRLMKTSR	Market Surplus Function for Rice
		PUNJAB RICE ZONE
		ZONAL RESOURCE RESTRICTIONS
99	PRRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
100	PRRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
101	PRRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
102	PLRFENK	Fertilizer Nitrogen, Kharif
103	PLRFEPK	Fertilizer Phosphorus, Kharif
104	PLRFEKK	Fertilizer Potash, Kharif
105	PRRBULK	Bullock, Kharif
106	PRRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
107	PRRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
108	PRRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
109	PLRFENR	Fertlizer Nitrogen, Rabi
110	PLRFEPR	Fertilizer Phosphorus, Rabi
111	PLRFEKR	Fertilizer Potash, Rabi
112	PRRBULR	Bullock, Rabi
113	PRRFYM	Farm Yard Manure
114	PRRTOWK	Total Water Requirements, Kharif
115	PRRTOWR	Total Water Requirements, Rabi
116	PRRCAWK	Limits on Canal Water, Kharif
117	PRRCAWR	Limits on Canal Water, Rabi
118	PRRTUWK	Limits on Tubewell Water, Kharif
119	PRRTUWR	Limits on Tubewell Water, Rabi
		PUNJAB RICE ZONE LIVESTOCK FEED RATIONS
		(Supply and Demand Balance Rows)
120	PRFFEED	Feed
121	PRFCAKE	Cake
122	PRFSTRAW	Straw
123	PRFGREK	Green, Kharif
124	PRFGRER	Green Rabi
125	PRFPAST	Pasture

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Row	Name	Description
126	PRFFISHM	Fishmeal
		PUNJAB RICE ZONE HERD LEVELS
127	PRHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
128	PRHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
129	PRHLGOSH	Herd Level Goats and Sheep
130	PRHLBRO	Herd Level Broilers
131	PRHLLAY	Herd Level Layers
132	PRHLDESI	Herd Level Desi Chicken
		PUNJAB SUGARCANE ZONE
		SMALL FARM RESOURCE RESTRICTIONS
133	PSSRFALK	Family Labor inc. ploughing, Kharif
134	PSSRLAK	Land Availability, Kharif
135	PSSRFALR	Family Labor inc. ploughing, Rabi
136	PSSRLAR	Land Availability, Rabi
137	PSSROBCW	Rotation Limits for Basmati, Cotton and Wheat
138	PSSMKTSW	Market Surplus Function for Wheat
139	PSSMKTSR	Market Surplus Function for Rice
		PUNJAB SUGARCANE ZONE
		MEDIUM FARM RESOURCE RESTRICTIONS
140	PSMRFALK	Family Labor inc. ploughing, Kharif
141	PSMRLAK	Land Availability, Kharif
142	PSMRFALR	Family Labor inc. ploughing, Rabi
143	PSMRLAR	Land Availability, Rabi
144	PSMROBCW	Rotation Limits for Basmati, Cotton and Wheat
145	PSMMKTSW	Market Surplus Function for Wheat
146	PSMMKTSR	Market Surplus Function for Rice
		PUNJAB SUGARCANE ZONE
		LARGE FARM RESOURCE RESTRICTIONS
147	PSLRFALK	Family Labor inc. ploughing, Kharif
148	PSLRLAK	Land Availability, Kharif
149	PSLRFALR	Family Labor inc. ploughing, Rabi
150	PSLRLAR	Land Availability, Rabi
151	PSLROBCW	Rotation Limits for Basmati, Cotton and Wheat
152	PSLMKTSW	Market Surplus Function for Wheat
153	PSLMKTSR	Market Surplus Function for Rice
		PUNJAB SUGARCANE ZONE
		ZONAL RESOURCE RESTRICTIONS
154	PSRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
155	PSRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
156	PSRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
157	PLSFENK	Fertilizer Nitrogen, Kharif
158	PLSFEPK	Fertilizer Phosphorus, Kharif
159	PLSFEKK	Fertilizer Potash, Kharif
160	PSRBULK	Bullock, Kharif
161	PSRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
162	PSRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
163	PSRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
164	PLSFENR	Fertilizer Nitrogen, Rabi
165	PLSFEPR	Fertilizer Phosphorus, Rabi
166	PLSFEKR	Fertilizer Potash, Rabi
167	PSRBULR	Bullock, Rabi

Row	Name	Description
168	PSRFYM	Farm Yard Manure
169	PSRTOWK	Total Water Requirements, Kharif
170	PSRTOWR	Total Water Requirements, Rabi
171	PSRCAWK	Limits on Canal Water, Kharif
172	PSRCAWR	Limits on Canal Water, Rabi
173	PSRTUWK	Limits on Tubewell Water, Kharif
174	PSRTUWR	Limits on Tubewell Water, Rabi
		PUNJAB SUGARCANE ZONE LIVESTOCK FEED RATIONS
		(Supply and Demand Balance Rows)
175	PSFFEED	Feed
176	PSFCAKE	Cake
177	PSFSTRAW	Straw
178	PSFGREK	Green, Kharif
179	PSFGRER	Green Rabi
180	PSFPAST	Pasture
181	PSFFISHM	Fishmeal
		PUNJAB SUGARCANE ZONE HERD LEVELS
182	PSHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
183	PSHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
184	PSHLGOSH	Herd Level Goats and Sheep
185	PSHLBRO	Herd Level Broilers
186	PSHLLAY	Herd Level Layers
187	PSHLDESI	Herd Level Desi Chicken
		PUNJAB COTTON ZONE
		SMALL FARM RESOURCE RESTRICTIONS
188	PCSRFALK	Family Labor inc. ploughing, Kharif
189	PCSRLAK	Land Availability, Kharif
190	PCSRFALR	Family Labor inc. ploughing, Rabi
191	PCSRLAR	Land Availability, Rabi
192	PCSROBCW	Rotation Limits for Basmati, Cotton and Wheat
193	PCSMKTSW	Market Surplus Function for Wheat
194	PCSMKTSR	Market Surplus Function for Rice
		PUNJAB COTTON ZONE
		MEDIUM FARM RESOURCE RESTRICTIONS
195	PCMRFALK	Family Labor inc. ploughing, Kharif
196	PCMRLAK	Land Availability, Kharif
197	PCMRFALR	Family Labor inc. ploughing, Rabi
198	PCMRLAR	Land Availability, Rabi
199	PCMROBCW	Rotation Limits for Basmati, Cotton and Wheat
200	PCMMKTSW	Market Surplus Function for Wheat
201	PCMMKTSR	Market Surplus Function for Rice
		PUNJAB COTTON ZONE
		LARGE FARM RESOURCE RESTRICTIONS
202	PCLRFALK	Family Labor inc. ploughing, Kharif
203	PCLRLAK	Land Availability, Kharif
204	PCLRFALR	Family Labor inc. ploughing, Rabi
205	PCLRLAR	Land Availability, Rabi
206	PCLROBCW	Rotation Limits for Basmati, Cotton and Wheat
207	PCLMKTSW	Market Surplus Function for Wheat
208	PCLMKTSR	Market Surplus Function for Rice

Row	Name	Description
		PUNJAB COTTON ZONE
		ZONAL RESOURCE RESTRICTIONS
209	PCRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
210	PCRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
211	PCRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
212	PLCFENK	Fertilizer Nitrogen, Kharif
213	PLCFEPK	Fertilizer Phosphorus, Kharif
214	PLCFEKK	Fertilizer Potash, Kharif
215	PCRBULK	Bullock, Kharif
216	PCRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
217	PCRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
218	PCRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
219	PLCFENR	Fertlizer Nitrogen, Rabi
220	PLCFEPR	Fertilizer Phosphorus, Rabi
221	PLCFEKR	Fertilizer Potash, Rabi
222	PCRBULR	Bullock, Rabi
223	PCRFYM	Farm Yard Manure
224	PCRTOWK	Total Water Requirements, Kharif
225	PCRTOWR	Total Water Requirements, Rabi
226	PCRCAWK	Limits on Canal Water, Kharif
227	PCRCAWR	Limits on Canal Water, Rabi
228	PCRTUWK	Limits on Tubewell Water, Kharif
229	PCRTUWR	Limits on Tubewell Water, Rabi
		PUNJAB COTTON ZONE LIVESTOCK FEED RATION
		(Supply and Demand Balance Rows)
230	PCFFEED	Feed
231	PCFCAKE	Cake
232	PCFSTRAW	Straw
233	PCFGREK	Green, Kharif
234	PCFGRER	Green Rabi
235	PCFPAST	Pasture
236	PCFFISHM	Fishmeal
		PUNJAB COTTON ZONE HERD LEVELS
237	PCHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
238	PCHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
239	PCHLGOSH	Herd Level Goats and Sheep
240	PCHLBRO	Herd Level Broilers
241	PCHLLAY	Herd Level Layers
242	PCHLDESI	Herd Level Desi Chicken

SIND REGION

		SIND PRODUCTION ROWS
		(Supply and Demand Balance Rows)
243	SIPRIO	Production of Rice (other)
244	SIPCOG	Production of Coarse Grains
245	SIPCOT	Production of Cotton
246	SIPSUG	Production of Sugarcane
247	SIPTOL	Production of Traditional Oilseed
248	SIPNOK	Production of Non-traditional Oilseeds, Kharif

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Row	Name	Description
249	SIPPUL	Production of Pulses
250	SIPHVA	Production of High Value Products
251	SIPWHE	Production of Wheat
252	SIPNOR	Production of Non-traditional Oilseeds, Rabi
253	SIPFRU	Production of Fruit
254	SIPMCA	Production of Milking Cows
255	SIPNMC	Production of Non-Milking Cows
256	SIPGOS	Production of Goats and Sheep
257	SIPPOU	Production of Poultry
258	SIPEGG	Production of Eggs
		SIND INPUT BALANCES
259	SIIFEN	Fertilizer Nitrogen
260	SIIFEP	Fertilizer Phosphorus
261	SIIFEK	Fertilizer Potash
262	SIIHL	Hired Labor
263	SIITTR	Total Tractors
		SIND REGIONAL RESOURCE RESTRICTIONS
264	SIRHLK	Supply-Demand Balance for Hired labor, Kharif
265	SIRHLR	Supply-Demand Balance for Hired labor, Rabi
266	SLIHLK	Hired Labor, Kharif
267	SLIHLR	Hired Labor, Rabi
		SIND RICE ZONE
		SMALL FARM RESOURCE RESTRICTIONS
268	SRSRFALK	Family Labor inc. ploughing, Kharif
269	SRSRLAK	Land Availability, Kharif
270	SRSRFALR	Family Labor inc. ploughing, Rabi
271	SRSRLAR	Land Availability, Rabi
272	SRSROBCW	Rotation Limits for Basmati, Cotton and Wheat
273	SRSMKTSW	Market Surplus Function for Wheat
274	SRSMKTSR	Market Surplus Function for Rice
		SIND RICE ZONE
		MEDIUM FARM RESOURCE RESTRICTIONS
275	SRMRFALK	Family Labor inc. ploughing, Kharif
276	SRMRLAK	Land Availability, Kharif
277	SRMRFALR	Family Labor inc. ploughing, Rabi
278	SRMRLAR	Land Availability, Rabi
279	SRMROBCW	Rotation Limits for Basmati, Cotton and Wheat
280	SRMMKTSW	Market Surplus Function for Wheat
281	SRMMKTSR	Market Surplus Function for Rice
		SIND RICE ZONE
		LARGE FARM RESOURCE RESTRICTIONS
282	SRLRFALK	Family Labor inc. ploughing, Kharif
283	SRLRLAK	Land Availability, Kharif
284	SRLRFALR	Family Labor inc. ploughing, Rabi
285	SRLRLAR	Land Availability, Rabi
286	SRLROBCW	Rotation Limits for Basmati, Cotton and Wheat
287	SRLMKTSW	Market Surplus Function for Wheat
288	SRLMKTSR	Market Surplus Function for Rice

SIND RICE ZONE
ZONAL RESOURCE RESTRICTIONS

289	SRRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
290	SRRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
291	SRRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
292	SLRFENK	Fertilizer Nitrogen, Kharif
293	SLRFEPK	Fertilizer Phosphorus, Kharif
294	SLRFEKK	Fertilizer Potash, Kharif
295	SRRBULK	Bullock, Kharif
296	SRRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
297	SRRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
298	SRRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
299	SLRFENR	Fertlizer Nitrogen, Rabi
300	SLRFEPR	Fertilizer Phosphorus, Rabi
301	SLRFEKR	Fertilizer Potash, Rabi
302	SRRBULR	Bullock, Rabi
303	SRRFYM	Farm Yard Manure
304	SRRTOWK	Total Water Requirements, Kharif
305	SRRTOWR	Total Water Requirements, Rabi
306	SRRCAWK	Limits on Canal Water, Kharif
307	SRRCAWR	Limits on Canal Water, Rabi
308	SRRTUWK	Limits on Tubewell Water, Kharif
309	SRRTUWR	Limits on Tubewell Water, Rabi

SIND RICE ZONE LIVESTOCK FEED RATIONS
(Supply and Demand Balance Rows)

310	SRFFEED	Feed
311	SRFCAKE	Cake
312	SRFSTRAW	Straw
313	SRFGREK	Green, Kharif
314	SRFGRER	Green Rabi
315	SRFPAST	Pasture
316	SRFFISHM	Fishmeal

SIND RICE ZONE HERD LEVELS

317	SRHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
318	SRHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
319	SRHLGOSH	Herd Level Goats and Sheep
320	SRHLBRO	Herd Level Broilers
321	SRHLLAY	Herd Level Layers
322	SRHLDESI	Herd Level Chicken Broilers

SIND COTTON ZONE
SMALL FARM RESOURCE RESTRICTIONS

323	SCSRFALK	Family Labor inc. ploughing, Kharif
324	SCSRLAK	Land Availability, Kharif
325	SCSRFALR	Family Labor inc. ploughing, Rabi
326	SCSRLAR	Land Availability, Rabi
327	SCSROBCW	Rotation Limits for Basmati, Cotton and Wheat
328	SCSMKTSW	Market Surplus Function for Wheat
329	SCSMKTSR	Market Surplus Function for Rice

SIND COTTON ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

330	SCMRFALK	Family Labor inc. ploughing, Kharif
331	SCMRLAK	Land Availability, Kharif
332	SCMRFALR	Family Labor inc. ploughing, Rabi
333	SCMRLAR	Land Availability, Rabi

Row	Name	Description
334	SCMROBCW	Rotation Limits for Basmati, Cotton and Wheat
335	SCMMKTSW	Market Surplus Function for Wheat
336	SCMMKTSR	Market Surplus Function for Rice
		SIND COTTON ZONE
		LARGE FARM RESOURCE RESTRICTIONS
337	SCLRFALK	Family Labor inc. ploughing, Kharif
338	SCLRLAK	Land Availability, Kharif
339	SCLRFALR	Family Labor inc. ploughing, Rabi
340	SCLRLAR	Land Availability, Rabi
341	SCLROBCW	Rotation Limits for Basmati, Cotton and Wheat
342	SCLMKTSW	Market Surplus Function for Wheat
343	SCLMKTSR	Market Surplus Function for Rice
		SIND COTTON ZONE
		ZONAL RESOURCE RESTRICTIONS
344	SCRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
345	SCRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
346	SCRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
347	SLCFENK	Fertilizer Nitrogen, Kharif
348	SLCFEPK	Fertilizer Phosphorus, Kharif
349	SLCFEKK	Fertilizer Potash, Kharif
350	SCRBULK	Bullock, Kharif
351	SCRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
352	SCRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
353	SCRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
354	SLCFENR	Fertlizer Nitrogen, Rabi
355	SLCFEPR	Fertilizer Phosphorus, Rabi
356	SLCFEKR	Fertilizer Potash, Rabi
357	SCRBULR	Bullock, Rabi
358	SCRFYM	Farm Yard Manure
359	SCRTOWK	Total Water Requirements, Kharif
360	SCRTOWR	Total Water Requirements, Rabi
361	SCRCAWK	Limits on Canal Water, Kharif
362	SCRCAWR	Limits on Canal Water, Rabi
363	SCRTUWK	Limits on Tubewell Water, Kharif
364	SCRTUWR	Limits on Tubewell Water, Rabi
		SIND COTTON ZONE LIVESTOCK FEED RATIONS
		(Supply and Demand Balance Rows)
365	SCFFEED	Feed
366	SCFCAKE	Cake
367	SCFSTRAW	Straw
368	SCFGREK	Green, Kharif
369	SCFGRER	Green Rabi
370	SCFPAST	Pasture
371	SCFFISHM	Fishmeal
		SIND COTTON ZONE HERD LEVELS
372	SCHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
373	SCHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
374	SCHLGOSH	Herd Level Goats and Sheep
375	SCHLBRO	Herd Level Broilers
376	SCHLLAY	Herd Level Layers
377	SCHLDESI	Herd Level Desi Chicken

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Row	Name	Description

BALUCHISTAN REGION

		BALUCHISTAN PRODUCTION ROWS
		(Supply and Demand Balance Rows)
378	BAPRIB	Production of Rice Basmati
379	BAPRIO	Production of Rice (other)
380	BAPCOG	Production of Coarse Grains
381	BAPSUG	Production of Sugarcane
382	BAPTOL	Production of Traditional Oilseed
383	BAPPUL	Production of Pulses
384	BAPVEG	Production of High Value Products
385	BAPWHE	Production of Wheat
386	BAPFRU	Production of Fruit
387	BAPMCA	Production of Milking Cows
388	BAPNMC	Production of Non-Milking Cows
389	BAPGOS	Production of Goats and Sheep
390	BAPPOU	Production of Poultry
391	BAPEGG	Production of Eggs
		BALUCHISTAN INPUT BALANCES
392	BAIFEN	Fertilizer Nitrogen
393	BAIFEP	Fertilizer Phosphorus
394	BAIFEK	Fertilizer Potash
395	BAIHL	Hired Labor
396	BAITTR	Total Tractors
		BALUCHISTAN REGIONAL RESOURCE RESTRICTIONS
397	BARFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
398	BARFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
399	BARFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
400	BLAFENK	Fertilizer Nitrogen, Kharif
401	BLAFEPK	Fertilizer Phosphorus, Kharif
402	BLAFEKK	Fertilizer Potash, Kharif
403	BARBULK	Bullock, Kharif
404	BARFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
405	BARFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
406	BARFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
407	BLAFENR	Fertlizer Nitrogen, Rabi
408	BLAFEPR	Fertilizer Phosphorus, Rabi
409	BLAFEKR	Fertilizer Potash, Rabi
410	BARBULR	Bullock, Rabi
411	BARFYM	Farm Yard Manure
412	BARTOWK	Total Water Requirements, Kharif
413	BARTOWR	Total Water Requirements, Rabi
414	BARCAWK	Limits on Canal Water, Kharif
415	BARCAWR	Limits on Canal Water, Rabi
416	BARTUWK	Limits on Tubewell Water, Kharif
417	BARTUWR	Limits on Tubewell Water, Rabi
418	BARHLK	Supply Demand for Hired Labor, Kharif
419	BARHLR	Supply Demand for Hired Labor, Rabi
420	BLAHLK	Limits on Hired Labor, Kharif
421	BLAHLR	Limits on Hired Labor, Rabi

Row	Name	Description
		BALUCHISTAN
		SMALL FARM RESOURCE RESTRICTIONS
422	BASRFALK	Family Labor inc. ploughing, Kharif
423	BASRLAK	Land Availability, Kharif
424	BASRFALR	Family Labor inc. ploughing, Rabi
425	BASRLAR	Land Availability, Rabi
426	BASROBCW	Rotation Limits for Basmati, Cotton and Wheat
427	BASMKTSW	Market Surplus Function for Wheat
428	BASMKTSR	Market Surplus Function for Rice
		BALUCHISTAN
		MEDIUM FARM RESOURCE RESTRICTIONS
429	BAMRFALK	Family Labor inc. ploughing, Kharif
430	BAMRLAK	Land Availability, Kharif
431	BAMRFALR	Family Labor inc. ploughing, Rabi
432	BAMRLAR	Land Availability, Rabi
433	BAMROBCW	Rotation Limits for Basmati, Cotton and Wheat
434	BAMMKTSW	Market Surplus Function for Wheat
435	BAMMKTSR	Market Surplus Function for Rice
		BALUCHISTAN
		LARGE FARM RESOURCE RESTRICTIONS
436	BALRFALK	Family Labor inc. ploughing, Kharif
437	BALRLAK	Land Availability, Kharif
438	BALRFALR	Family Labor inc. ploughing, Rabi
439	BALRLAR	Land Availability, Rabi
440	BALROBCW	Rotation Limits for Basmati, Cotton and Wheat
441	BALMKTSW	Market Surplus Function for Wheat
442	BALMKTSR	Market Surplus Function for Rice
		BALUCHISTAN LIVESTOCK FEED RATIONS
		(Supply and Demand Balance Rows)
443	BAFFEED	Feed
444	BAFCAKE	Cake
445	BAFSTRAW	Straw
446	BAFGREK	Green, Kharif
447	BAFGRER	Green Rabi
448	BAFPAST	Pasture
449	BAFFISHM	Fishmeal
		BALUCHISTAN HERD LEVELS
450	BAHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
451	BAHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
452	BAHLGOSH	Herd Level Goats and Sheep
453	BAHLBRO	Herd Level Broilers
454	BAHLLAY	Herd Level Layers
455	BAHLDESI	Herd Level Chicken Broilers

Row	Name	Description
		NWFP REGION
		NWFP PRODUCTION ROWS
		(Supply and Demand Balance Rows)
456	NPPRIB	Production of Rice Basmati
457	NPPRIO	Production of Rice (other)
458	NPPCOG	Production of Coarse Grains
459	NPPCOT	Production of Cotton
460	NPPSUG	Production of Sugarcane
461	NPPTOL	Production of Traditional Oilseed
462	NPPNOK	Production of Non-traditional Oilseeds, Kharif
463	NPPPUL	Production of Pulses
464	NPPVEG	Production of High Value Products
465	NPPWHE	Production of Wheat
466	NPPNOR	Production of Non-traditional Oilseeds, Rabi
467	NPPFRU	Production of Fruit
468	NPPMCA	Production of Milking Cows
469	NPPNMC	Production of Non-Milking Cows
470	NPPGOS	Production of Goats and Sheep
471	NPPPOU	Production of Poultry
472	NPPEGG	Production of Eggs
		NWFP INPUT BALANCES
473	NPIFEN	Fertilizer Nitrogen
474	NPIFEP	Fertilizer Phosphorus
475	NPIFEK	Fertilizer Potash
476	NPIHL	Hired Labor
477	NPITTR	Total Tractors
		NWFP REGIONAL RESOURCE RESTRICTIONS
478	NPRFENK	Supply-Demand Balance, Nitrogen Fertilizer, Kharif
479	NPRFEPK	Supply-Demand Balance, Phosphorous Fertilizer, Kharif
480	NPRFEKK	Supply-Demand Balance, Potash Fertilizer, Kharif
481	NPLFENK	Fertilizer Nitrogen, Kharif
482	NPLFEPK	Fertilizer Phosphorus, Kharif
483	NPLFEKK	Fertilizer Potash, Kharif
484	NPRBULK	Bullock, Kharif
485	NPRFENR	Supply-Demand Balance, Nitrogen Fertilizer, Rabi
486	NPRFEPR	Supply-Demand Balance, Phosphorous Fertilizer, Rabi
487	NPRFEKR	Supply-Demand Balance, Potash Fertilizer, Rabi
488	NLPFENR	Fertilizer Nitrogen, Rabi
489	NLPFEPR	Fertilizer Phosphorus, Rabi
490	NPLFEKR	Fertilizer Potash, Rabi
491	NPRBULR	Bullock, Rabi
492	NPRFYM	Farm Yard Manure
493	NPRTOWK	Total Water Requirements, Kharif
494	NPRTOWR	Total Water Requirements, Rabi
495	NPRCAWK	Limits on Canal Water, Kharif
496	NPRCAWR	Limits on Canal Water, Rabi
497	NPRTUWK	Limits on Tubewell Water, Kharif
498	NPRTUWR	Limits on Tubewell Water, Rabi
499	NPRHLK	Supply Demand for Hired Labor, Kharif
500	NPRHLR	Supply Demand for Hired Labor, Rabi
501	NLPHLK	Limits on Hired Labor, Kharif
502	NLPHLR	Limits on Hired Labor, Rabi

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Row	Name	Description
		NWFP
		SMALL FARM RESOURCE RESTRICTIONS
503	NPSRFALK	Family Labor inc. ploughing, Kharif
504	NPSRLAK	Land Availability, Kharif
505	NPSRFALR	Family Labor inc. ploughing, Rabi
506	NPSRLAR	Land Availability, Rabi
507	NPSROBCW	Rotation Limits for Basmati, Cotton and Wheat
508	NPSMKTSW	Market Surplus Function for Wheat
509	NPSMKTSR	Market Surplus Function for Rice
		NWFP
		MEDIUM FARM RESOURCE RESTRICTIONS
510	NPMRFALK	Family Labor inc. ploughing, Kharif
511	NPMRLAK	Land Availability, Kharif
512	NPMRFALR	Family Labor inc. ploughing, Rabi
513	NPMRLAR	Land Availability, Rabi
514	NPMROBCW	Rotation Limits for Basmati, Cotton and Wheat
515	NPMMKTSW	Market Surplus Function for Wheat
516	NPMMKTSR	Market Surplus Function for Rice
		NWFP
		LARGE FARM RESOURCE RESTRICTIONS
517	NPLRFALK	Family Labor inc. ploughing, Kharif
518	NPLRLAK	Land Availability, Kharif
519	NPLRFALR	Family Labor inc. ploughing, Rabi
520	NPLRLAR	Land Availability, Rabi
521	NPLROBCW	Rotation Limits for Basmati, Cotton and Wheat
522	NPLMKTSW	Market Surplus Function for Wheat
523	NPLMKTSR	Market Surplus Function for Rice
		NWFP LIVESTOCK FEED RATIONS
		(Supply and Demand Balance Rows)
524	NPFLFEED	Feed
525	NPFCAKE	Cake
526	NPFSTRAW	Straw
527	NPFGREK	Green, Kharif
528	NPFGRER	Green Rabi
529	NPFPAST	Pasture
530	NPFFISHM	Fishmeal
		NWFP HERD LEVELS
531	NPHLMCA	Herd Level Milking Cows, Buffaloes, Goats and Sheep
532	NPHLNMCA	Herd Level Non-Milking Cows, Buffaloes, Goats and Sheep
533	NPHLGOSH	Herd Level Goats and Sheep
534	NPHLBRO	Herd Level Broilers
535	NPHLLAY	Herd Level Layers
536	NPHLDESI	Herd Level Chicken Broilers
		NATIONAL OILSEED PROCESSING
537	NAPCTS	National Procurement of Cottonseed
538	NIOTOL	National Processing of Traditional Oilseeds
539	NIONOL	National Processing of Non-Traditional Oilseeds
540	NIOCTS	National Processing of Cottonseed
541	NSELCAK	Sales of Feedcake to Zones for Ration Inputs

Row	Name	Description
		LIMITS ON IMPORTS AND EXPORTS
542	EXLRIB	Export Limit on Basmati Rice
543	EXLRIO	Export Limit on Rice Other and Flour
544	EXLCTF	Export Limit on Cotton Fiber
545	EXLVEG	Export Limit on Vegetables
546	EXLFRU	Export Limit on Fruits
547	IMLSUG	Import Limit on Sugar
548	IMLPUL	Import Limit on Pulses
549	IMLWHE	Import Limit on Wheat and Wheat Products
550	IMLSOYO	Import Limit on Soybean Oil
551	IMLPALO	Import Limit on Palm Oil
552	IMLMIL	Import Limit on Milk
		SELECTED LIMITS ON ACREAGES IN PRODUCTION
553	LIMTOK	Acreage Limits on Traditional Oilseeds, Kharif
554	LIMNOK	Acreage Limits on Non-traditional Oilseeds, Kharif
555	LIMTOR	Acreage Limits on Traditional Oilseeds, Rabi
556	LIMNOR	Acreage Limits on Non-traditional Oilseeds, Rabi
557	LIMPUL	Acreage Limits on Pulses, Kharif
558	LIMFOK	Acreage Limits on Fodder, Kharif

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A6.2 A Description of the Activities (Columns) in the Model

Zonal Level Activities

Crop Production Columns [(Punjab Rice (Zone 1): Cols. 1 - 60; Punjab Sugarcane (Zone 2): Cols. 89 - 148; Punjab Cotton (Zone 3): Cols. 177 - 236; Sind Rice (Zone 4): Cols. 314 - 370; Sind Cotton (Zone 5): Cols. 399-455; Baluchistan (Zone 6): Cols. 525 - 572; NWFP Zones 7 and 8): Cols. 632 -745)]. The farm production activities are the alternatives the model has for producing each of the different crops. The units are thousands of hectares of land. For example, if the model chooses the activity PS1RIB, it chooses to produce a certain number of hectares of basmati rice on small farms in the Rice zone of the Punjab. All production columns begin with a "P" in the first position. Then the zone and size of farm are given. The second letter is an S, M, or L, depending on whether the production is taking place on a farm which is Small, Medium, or Large. The third place in the name will give the zone. In the Punjab, zone 1 is the Rice zone, zone 2 is the Sugarcane zone, and zone 3 is the Cotton Zone. The Sind is broken into two zones, Rice, zone 4, and Cotton, Zone 5. The last three positions designate the crop being produced. In kharif, these are: RIB, Basmati Rice; RIO, Other Rice; COG, Coarse Grain; CO3, Three-Picking Cotton; CO4, Four-Picking Cotton; SUG, Sugarcane; TOK, Traditional Oilseeds (K for Kharif); NOK, Non-traditional Oilseeds (K for Kharif); PUK, Pulses, (K for Kharif); VEK; Vegetables (K for Kharif); FDK, Fodder (K for Kharif). In Rabi, the production options are: WHE, Wheat; WHL, Late Wheat; BAR, Barley; PUR, Pulses (R for Rabi); HVA, Vegetables (R for Rabi); TOR, Traditional Oilseeds (R for Rabi); NOR, Non-traditional Oilseeds (R for Rabi); FDR, Fodder (R for Rabi); FRU, Fruit. Sugarcane and Fruit require land in both kharif and rabi seasons.

Livestock Maintenance Activities. [(Punjab Rice (Zone 1): Cols. 61 - 78; Punjab Sugarcane (Zone 2): Cols. 149 - 166; Punjab Cotton (Zone 3): Cols. 237 - 254; Sind Rice (Zone 4): Cols. 371 - 388; Sind Cotton (Zone 5): Cols. 456-473; Baluchistan (Zone 6): Cols. 573 - 590; NWFP Zones 7 and 8): Cols. 746 -781)]. Livestock must be provided with enough rations for herds to survive at certain levels in each zone. The model could choose an activity such as L1MCA2, which puts some number of milking cows and buffaloes on ration 2. That ration is composed of a specific combination of inputs used in making feed for the livestock. (See the discussion of the Zonal Livestock feed rations for the types of inputs used to create the rations). Livestock maintenance activity columns all begin with an "L", and then the designation of the zone using the numbers shown before. The next three positions in the name reflect the types of livestock: MCA, Milking Cows/Buffaloes; NMC, Non-Milking Cows/Buffaloes; GOS, Goats and Sheep; BRO, Broilers; LAY, Laying Hens; DESI, Desi Chickens. The final position in the title of the activity is the ration number. These correspond to different performances levels for the rations. Usually ration 1 is a "survival" ration, and the rations become better as the number increases. When there are four rations, the two are usually equivalent in terms of performance but are based on different combinations of inputs. (See Annex V for details on the structure of the livestock rations).

Household Purchases of Basic Commodities. [(Punjab Rice (Zone 1): Cols. 79 - 84; Punjab Sugarcane (Zone 2): Cols. 167 - 172; Punjab Cotton (Zone 3): Cols. 255 - 260; Sind Rice (Zone 4): Cols. 389 - 394; Sind Cotton (Zone 5): Cols. 474-479; Baluchistan (Zone 6): Cols. 591 - 596; NWFP (Zone 7): Cols. 782 -787)] Each size of farm has the option to produce either for home consumption or to purchase the major commodities, wheat and rice, from retailers. The difference is that the model charges an extra marketing cost if the farm household decides to go through the marketing system rather than produce the commodity for themselves. The metric tons purchased from retail are given by activities such as HS1WHE, which indicates the volume of wheat purchased from retail by small farms in the Rice Zone of the Punjab. The title shows an "H" in the first position, for home purchases, the size of the farm in the second position, the zone in the third position, and either WHE (for wheat) or RIC (for all rice) in the last three positions.

Input Balances for Water. [(Punjab Rice (Zone 1): Cols. 85 - 88; Punjab Sugarcane (Zone 2): Cols. 173 - 176; Punjab Cotton (Zone 3): Cols. 261 - 264; Sind Rice (Zone 4): Cols. 395 - 398; Sind Cotton (Zone 5): Cols. 480-483; Baluchistan (Zone 6): Cols. 597 - 600; NWFP (Zone 7): Cols. 788 -791)]. Water is available in limited amounts for each zone, and separately for canal and tubewell water. The activities which account for the total water used are those such as IB1CAK. The first two letters indicate that the activity is an input balance (IB), the third letter refers to the zone, and the last three letters indicate the type of water in question. The different types are: CAK, Canal Water, Kharif; CAR, Canal Water, Rabi; TUK, Tubewell Water, Kharif; TUR, Tubewell Water, Rabi.

Regional Activities

Those columns referring to activities which take place in each region, as opposed to a zone or at the national level, are discussed in this section.

Accounting Rows for Priced Inputs. [Punjab Region: Cols. 265 - 284; Sind Region: Cols. 285 - 289; Baluchistan Region: Cols. 601 - 608; NWFP Region: Cols. 792 -799)]. Certain major inputs are priced at the regional level; activities which accumulate the total quantity that needs to priced are found in this section of columns. Each of these activities begins with an "A" to indicate that it is an accounting column that records the total use of each input. The zone is in the second position, running from 1 to 7. Fertilizer is priced at the regional level but is constrained in quantity at the zonaL level, so the quantities used are accumulated at that level. The last four letters in the name refer to the input being totaled: FENK, Nitrogen Fertilizer, Kharif; FEPK, Phosphatic Fertilizer, Kharif; FEKK, Potash Fertilizer, Kharif; FENR, Nitrogen Fertilizer, Rabi; FEPR, Phosphatic Fertilizer, Rabi; FEKR, Potash Fertilizer, Rabi. The names are slightly different for hired labor, which is constrained only at the regional level. After the "A" in the first position, there is a two letter designation of the region: PU -- Punjab, SI -- Sind, BA -- Baluchistan and NP for NWFP. The last three letters are either HLK or HLR, showing hired labor in kharif or rabi. Thus, APUHLK would be the total usage of hired labor, Kharif, in the whole Punjab region.

Regional Input Balances. [Punjab Region: Cols. 285 - 289; Sind Region: Cols. 498 - 502; Baluchistan Region: Cols. 609 - 613; NWFP Region: Cols. 800 -804)]. The activities which price inputs in the objective function are the input balance rows. Prices are allowed to vary by region, so that these columns show up in each of the four provinces. The reasons that two apparently similar sets of columns exist, accounting rows and input balance rows, is in order to have the coefficients entered into the model only once. For Nitrogen fertilizer, for example, the accounting rows sum up the demand for fertilizer in each of zones, and those columns are in turn summed to get the total used in the region. Likewise, the hired labor requirement for each season are brought together in the input balance columns after having been summed in the accounting rows. The name begins with an "I", indicating that it is for an input balance, and then two letters refer to the region. The final letters in the name show the input: FEN, Nitrogen Fertilizer; FEP, Phosphatic Fertilizer; FEK, Potash Fertilizer; HL, Hired Labor; TTR, Tractor Services. Note that the reference to season has been dropped because these columns include both kharif and rabi.

Regional Domestic Marketing Activities. [Punjab Region: Cols. 290 - 308; Sind Region: Cols. 503 - 520; Baluchistan Region: Cols. 614 - 629; NWFP Region: Cols. 805 - 823)]. The production activities show the hectares of production in each zone. The marketing of each product to final demand comes out of in each region and are described under these headings. Also, these activities are in metric tons at the farm level (except for eggs, which are in millions of eggs), so they give a measure of volume of farm production at the retail level. The names of these columns all begin with an "M" to indicate that they are marketing activities; the next two letters show the region, and the last three letters denote the farm level product being marketed. These symbols are essentially the same as those presented in the production section above. The main differences are that NMC now refers to Beef, the product of non-milking cows and buffaloes, and MCA refers to Milk, the output from milking cows and buffaloes. Otherwise, the products are the same as those in the production section.

Regional Export Activities. [Punjab Region: Cols. 309 - 313; Sind Region: Cols. 521 - 524; Baluchistan Region: Cols. 630 - 631; NWFP Region: Cols. 832 -833)]. In addition to selling to domestic markets, it is possible for production in each of the regions to be sold to foreign markets, at least for certain products. Activities which record the amount of production going to exports begin with an "M"just as do domestic marketing activities. The second letter is an "X',indicating that the marketing is to exports, the third letter is a P,S, B, or N depending on the region, and the last three letters give the product: RIB, Export Marketing of Basmati Rice; RIO, Export Marketing of Other Rice; CTF, Export Marketing of Cotton Fiber; VEG, Export Marketing of Vegetables; FRU, Export Marketing of Fruit.

National Level Activities

Activities relating to oilseed processing and livestock feeding, domestic demand functions, and exports and imports are all specified at the national level. The regional

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activities shown earlier are tied ultimately to these functions when appropriate.

Oilseed Cake Feeding to Livestock. [Columns 824 - 830]. The livestock rations include a component for oilseed cake, which is therefore demanded in each zone. The demands are aggregated together from all types of livestock in seven columns. They all begin with a "DF" indicating the activity is a demand activity, albeit for an intermediate product, feed. The third position in the name has the zone designation in it, from 1 to 7. The last three positions are all "CAK", showing that it is a demand for cake.

National Marketing of Cottonseed. [Column 831]. Cottonseed does not go out through regular regional demand activities, but rather is brought into supply as a by-product of cotton fiber production. The total availability of cottonseed is summed up from all production activities for cotton in a variable called MNACTS.

Domestic Demand Functions. [Columns 834 - 1031]. The demand functions have eleven points which provide alternative quantities for each commodity and imply different prices. Thus the model can choose different quantities to be demanded for each product. Each demand point has a "D" in the first position indicating that it is a demand function. The next three letters signify the commodity being modelled, and the last two positions have values from 1 to 11 to show which point is referred to by the column. The commodities are somewhat different for the production level activities, although many are the same. Their symbols are: RIB, Basmati Rice; RIO, Other Rice; COG, Coarse Grain; CTF, Cotton Fiber; SUG, Sugar; PUL, Pulses; VEG, Vegetables; FRU, Fruit; WHE, Wheat; VGE, Vegetable Ghee; LOI, Liquid Oil; BEE, Beef; MIL, Milk; BUT, Butter; AGE; Animal Ghee; MUT, Mutton; POU, Poultry (Chicken Meat); EGG, Eggs.

Domestic Processing of Vegetable Ghee and Liquid Oil. [Columns 1032 - 1037]. Most commodities are simply converted from farm level to retail quantities in the marketing activities, where conversion factors are included. However, to illustrate a different approach and to set the stage for a special oilseeds simulation, processing activities are separated from marketing activities for edible oils. Also, because edible oils come from different raw materials and which have different proportions of cake and feed, several activities are needed to process the individual products. Liquid oils and hydrogenated vegetable ghee are treated as separate products in both consumption and production All ghee products begin with "VGD" for Domestic Vegetable Ghee, while the liquid oil begins with "LOI". The last three letters indicate the type of raw product being processed: TOL, traditional Oilseeds (mainly Rapeseed and Mustard); NOL, non-traditional oilseeds, including sunflower, soybean and sesame; and CTS, cottonseed.

Import-to-Retail Handling and Marketing. [Columns 1038 -- 1041]. Most products which are imported come as raw or intermediate product and require further processing and distribution in order to reach the final consumer. These costs are added by putting imports through a separate import-to-retail marketing activity, which always begins with a "MIR" in

the first three positions. Sugar, wheat, milk, and pulses are the products which are imported and need these marketing services. Thus the final three letters are either SUG, WHE, MIL, or PUL.

Processing and Marketing of Imported Vegetable Ghee and Liquid Oil. [Columns 1042-1047]. Palm and soybean are the two oils which are imported for processing into ghee and liquid oil. After importing, they are processed in one step and then distributed in a second step. The activities VGESOY and VGEPAL are the processing of imported soybean and palm oils into vegetable ghee. Similarly, LOISOY and LOIPAL refer to liquid oil. After processing the distribution costs from processing to retail are accounted for in the activities MIPSOY and MIPPAL.

Imports and Exports. [Columns 1048 - 1068]. When imports are demanded or exports are profitable to sell, their quantities are recorded in the activities in these columns. Imports all begin with an "IM",which is followed by the product designation: SUG, Sugar; PUL, Pulses; WHE, Wheat; SOYO, Soybean Oil; PALO, Palm Oil;
and MIL, Milk. Likewise, with the exception of basmati rice, exports being with an "EX"and are followed by the commodity indicator: RIO, Other Rice; CTF, Cotton Fiber; VEG, Vegetables; FRU, Fruit. The one export which is specified in a different manner is basmati rice, which is constructed similarly to the domestic demand curve to reflect Pakistan's position as a large country exporter. Thus there are 11 points used to specify price-quantity relationships. Each one begins with is DRIE, Demand for Rice (basmati) exports, and is followed by a number from 1 to 11 showing the points on the demand curve.

Farm Income Accounting Column. [Column 1069]. The final activity in the model is used to estimate net farm income farm income. The activity balances the net of revenues received from selling to final demand and costs incurred in supplying and marketing crops and livestock. The activity which sums all of this up is AFARMI.

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UNITS FOR COLUMNS IN PASM

Column Type	Units
Crop Production Columns	'000 Hectares
Livestock Maintenance Activities	Standard Animal Units, '000
Household Purchases of Basic Commodities	Metric Tons at Farm Level.
Input Balances for Water	Millions of Acre Feet
Accounting Rows for Priced Inputs Resource Restrictions	Fertilizer, Nutrient Tons; Hired and Labor, '000 Man-hours. Fertilizer, Nutrient Tons; Hired Labor, '000 Man-hours; Tractor Services, '000 Service Hours
Regional Domestic Marketing Activities	Metric Tons at Farm Level.
Regional Export Activities	Metric Tons at Farm Level
Oilseed Cake Feeding to Livestock	Metric Tons of Oilseed Cake
National Marketing of Cottonseed	Metric Tons at Farm Level
Domestic Demand Functions	No Units; Quantities are in Tableau
Domestic Processing of Vegetable Ghee and Liquid Oil	Metric Tons of Oilseed
Import-to-Retail Handling and Marketing	Metric Tons at Import Level.
Processing and Marketing of Imported Vegetable Ghee and Liquid Oil	Metric Tons of Imported Oil
Imports and Exports	Metric Tons, FOB or CIF Karachi
Farm Income Accounting Column	Billions of Rupees.

PUNJAB REGION

Production in Punjab Rice Zone
Small Farms

1	PS1RIB	Small Farm Production of Basmati Rice
2	PS1RIO	Small Farm Production of Other Rice
3	PS1COG	Small Farm Production of Coarse Grain
4	PS1CO3	Small Farm Production of Three-Picking Cotton
5	PS1CO4	Small Farm Production of Four-Picking Cotton
6	PS1SUG	Small Farm Production of Sugar
7	PS1TOK	Small Farm Production of Trad. Oilseeds, Kharif
8	PS1NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
9	PS1PUK	Small Farm Production of Pulses, Kharif
10	PS1VEK	Small Farm Production of Vegetables, Kharif
11	PS1FDK	Small Farm Production of Fodder, Kharif
12	PS1WHE	Small Farm Production of Wheat
13	PS1WHL	Small Farm Production of Late Wheat
14	PS1BAR	Small Farm Production of Barley
15	PS1PUR	Small Farm Production of Pulses, Rabi
16	PS1HVA	Small Farm Production of Vegetables, Rabi
17	PS1TOR	Small Farm Production of Trad. Oilseeds, Rabi
18	PS1NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
19	PS1FDR	Small Farm Production of Fodder, Rabi
20	PS1FRU	Small Farm Production of Fruit

Production in Punjab Rice Zone
Medium Farms

21	PM1RIB	Medium Farm Production of Basmati Rice
22	PM1RIO	Medium Farm Production of Other Rice
23	PM1COG	Medium Farm Production of Coarse Grain
24	PM1CO3	Medium Farm Production of Three-Picking Cotton
25	PM1CO4	Medium Farm Production of Four-Picking Cotton
26	PM1SUG	Medium Farm Production of Sugar
27	PM1TOK	Medium Farm Production of Trad. Oilseeds, Kharif
28	PM1NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
29	PM1PUK	Medium Farm Production of Pulses, Kharif
30	PM1VEK	Medium Farm Production of Vegetables, Kharif
31	PM1FDK	Medium Farm Production of Fodder, Kharif
32	PM1WHE	Medium Farm Production of Wheat
33	PM1WHL	Medium Farm Production of Late Wheat
34	PM1BAR	Medium Farm Production of Barley
35	PM1PUR	Medium Farm Production of Pulses, Rabi
36	PM1HVA	Medium Farm Production of Vegetables, Rabi
37	PM1TOR	Medium Farm Production of Trad. Oilseeds, Rabi
38	PM1NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
39	PM1FDR	Medium Farm Production of Fodder, Rabi
40	PM1FRU	Medium Farm Production of Fruit

Production in Punjab Rice Zone
Large Farms

41	PL1RIB	Large Farm Production of Basmati Rice
42	PL1RIO	Large Farm Production of Other Rice
43	PL1COG	Large Farm Production of Coarse Grain
44	PL1CO3	Large Farm Production of Three-Picking Cotton
45	PL1CO4	Large Farm Production of Four-Picking Cotton
46	PL1SUG	Large Farm Production of Sugar
47	PL1TOK	Large Farm Production of Trad. Oilseeds, Kharif
48	PL1NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
49	PL1PUK	Large Farm Production of Pulses, Kharif
50	PL1VEK	Large Farm Production of Vegetables, Kharif
51	PL1FDK	Large Farm Production of Fodder, Kharif

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Row	Name	Description
52	PL1WHE	Large Farm Production of Wheat
53	PL1WHL	Large Farm Production of Late Wheat
54	PL1BAR	Large Farm Production of Barley
55	PL1PUR	Large Farm Production of Pulses, Rabi
56	PL1HVA	Large Farm Production of Vegetables, Rabi
57	PL1TOR	Large Farm Production of Trad. Oilseeds, Rabi
58	PL1NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
59	PL1FDR	Large Farm Production of Fodder, Rabi
60	PL1FRU	Large Farm Production of Fruit
		Punjab Rice Zone
		Livestock Maintenance Activities
61	L1MCA1	Milking Cows/Buffaloes Maintained on Ration 1
62	L1MCA2	Milking Cows/Buffaloes Maintained on Ration 2
63	LIMCA3	Milking Cows/Buffaloes Maintained on Ration 3
64	L1NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
65	L1NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
66	L1NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
67	L1GOS1	Goats and Sheep Maintained on Ration 1
68	L1GOS2	Goats and Sheep Maintained on Ration 2
69	L1GOS3	Goats and Sheep Maintained on Ration 3
70	L1BRO1	Broilers Maintained on Ration 1
71	L1BRO2	Broilers Maintained on Ration 2
72	L1BRO3	Broilers Maintained on Ration 3
73	L1BRO4	Broilers Maintained on Ration 4
74	L1LAY1	Layers Maintained on Ration 1
75	L1LAY2	Layers Maintained on Ration 2
76	L1LAY3	Layers Maintained on Ration 3
77	L1LAY4	Layers Maintained on Ration 4
78	L1DESI	Desi Chicken Ration
		Punjab Rice Zone
		Household Purchases of Basic Commodities
79	HS1WHE	Small Farms' Household Purchases of Wheat
80	HS1RIC	Small Farms' Household Purchases of Rice
81	HM1WHE	Medium Farms' Household Purchases of Wheat
82	HM1RIC	Medium Farms' Household Purchases of Rice
83	HL1WHE	Large Farms' Household Purchases of Wheat
84	HL1RIC	Large Farms' Household Purchases of Rice
		Punjab Rice Zone
		Input Balances
85	IB1CAK	Input Balance for Canal Water, Kharif
86	IB1CAR	Input Balance for Canal Water, Rabi
87	IB1TUK	Input Balance for Tubewell Water, Karif
88	IB1TUR	Input Balance for Tubewell Water, Rabi
		PUNJAB SUGARCANE ZONE
		Production in Punjab Sugarcane Zone
		Small Farms
89	PS2RIB	Small Farm Production of Basmati Rice
90	PS2RIO	Small Farm Production of Other Rice
91	PS2COG	Small Farm Production of Coarse Grain
92	PS2CO3	Small Farm Production of Three-Picking Cotton
93	PS2CO4	Small Farm Production of Four-Picking Cotton
94	PS2SUG	Small Farm Production of Sugar

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Row	Name	Description
95	PS2TOK	Small Farm Production of Trad. Oilseeds, Kharif
96	PS2NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
97	PS2PUK	Small Farm Production of Pulses, Kharif
98	PS2VEK	Small Farm Production of Vegetables, Kharif
99	PS2FDK	Small Farm Production of Fodder, Kharif
100	PS2WHE	Small Farm Production of Wheat
101	PS2WHL	Small Farm Production of Late Wheat
102	PS2BAR	Small Farm Production of Barley
103	PS2PUR	Small Farm Production of Pulses, Rabi
104	PS2HVA	Small Farm Production of Vegetables, Rabi
105	PS2TOR	Small Farm Production of Trad. Oilseeds, Rabi
106	PS2NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
107	PS2FDR	Small Farm Production of Fodder, Rabi
108	PS2FRU	Small Farm Production of Fruit
		Production in Punjab Sugarcane Zone
		Medium Farms
109	PM2RIB	Medium Farm Production of Basmati Rice
110	PM2RIO	Medium Farm Production of Other Rice
111	PM2COG	Medium Farm Production of Coarse Grain
112	PM2CO3	Medium Farm Production of Three-Picking Cotton
113	PM2CO4	Medium Farm Production of Four-Picking Cotton
114	PM2SUG	Medium Farm Production of Sugar
115	PM2TOK	Medium Farm Production of Trad. Oilseeds, Kharif
116	PM2NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
117	PM2PUK	Medium Farm Production of Pulses, Kharif
118	PM2VEK	Medium Farm Production of Vegetables, Kharif
119	PM2FDK	Medium Farm Production of Fodder, Kharif
120	PM2WHE	Medium Farm Production of Wheat
121	PM2WHL	Medium Farm Production of Late Wheat
122	PM2BAR	Medium Farm Production of Barley
123	PM2PUR	Medium Farm Production of Pulses, Rabi
124	PM2HVA	Medium Farm Production of Vegetables, Rabi
125	PM2TOR	Medium Farm Production of Trad. Oilseeds, Rabi
126	PM2NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
127	PM2FDR	Medium Farm Production of Fodder, Rabi
128	PM2FRU	Medium Farm Production of Fruit
		Production in Punjab Sugarcane Zone
		Large Farms
129	PL2RIB	Large Farm Production of Basmati Rice
130	PL2RIO	Large Farm Production of Other Rice
131	PL2COG	Large Farm Production of Coarse Grain
132	PL2CO3	Large Farm Production of Three-Picking Cotton
133	PL2CO4	Large Farm Production of Four-Picking Cotton
134	PL2SUG	Large Farm Production of Sugar
135	PL2TOK	Large Farm Production of Trad. Oilseeds, Kharif
136	PL2NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
137	PL2PUK	Large Farm Production of Pulses, Kharif
138	PL2VEK	Large Farm Production of Vegetables, Kharif
139	PL2FDK	Large Farm Production of Fodder, Kharif
140	PL2WHE	Large Farm Production of Wheat
141	PL2WHL	Large Farm Production of Late Wheat
142	PL2BAR	Large Farm Production of Barley
143	PL2PUR	Large Farm Production of Pulses,Rabi
144	PL2HVA	Large Farm Production of Vegetables, Rabi
145	PL2TOR	Large Farm Production of Trad. Oilseeds, Rabi
146	PL2NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
147	PL2FDR	Large Farm Production of Fodder, Rabi

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Row	Name	Description
148	PL2FRU	Large Farm Production of Fruit
		Punjab Sugarcane Zone
		Livestock Maintenance Activities
149	L2MCA1	Milking Cows/Buffaloes Maintained on Ration 1
150	L2MCA2	Milking Cows/Buffaloes Maintained on Ration 2
151	L2MCA3	Milking Cows/Buffaloes Maintained on Ration 3
152	L2NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
153	L2NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
154	L2NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
155	L2GOS1	Goats and Sheep Maintained on Ration 1
156	L2GOS2	Goats and Sheep Maintained on Ration 2
157	L2GOS3	Goats and Sheep Maintained on Ration 3
158	L2BRO1	Broilers Maintained on Ration 1
159	L2BRO2	Broilers Maintained on Ration 2
160	L2BRO3	Broilers Maintained on Ration 3
161	L2BRO4	Broilers Maintained on Ration 4
162	L2LAY1	Layers Maintained on Ration 1
163	L2LAY2	Layers Maintained on Ration 2
164	L2LAY3	Layers Maintained on Ration 3
165	L2LAY4	Layers Maintained on Ration 4
166	L2DESI	Desi Chicken Ration
		Punjab Sugarcane Zone
		Household Purchases of Basic Commodities
167	HS2WHE	Small Farms' Household Purchases of Wheat
168	HS2RIC	Small Farms' Household Purchases of Rice
169	HM2WHE	Medium Farms' Household Purchases of Wheat
170	HM2RIC	Medium Farms' Household Purchases of Rice
171	HL2WHE	Large Farms' Household Purchases of Wheat
172	HL2RIC	Large Farms' Household Purchases of Rice
		Punjab Sugarcane Zone
		Input Balances
173	IB2CAK	Input Balance for Canal Water, Kharif
174	IB2CAR	Input Balance for Canal Water, Rabi
175	IB2TUK	Input Balance for Tubewell Water, Karif
176	IB2TUR	Input Balance for Tubewell Water, Rabi
		PUNJAB COTTON ZONE
		Production in Punjab Cotton Zone
		Small Farms
177	PS3RIB	Small Farm Production of Basmati Rice
178	PS3RIO	Small Farm Production of Other Rice
179	PS3COG	Small Farm Production of Coarse Grain
180	PS3CO3	Small Farm Production of Three-Picking Cotton
181	PS3CO4	Small Farm Production of Four-Picking Cotton
182	PS3SUG	Small Farm Production of Sugar
183	PS3TOK	Small Farm Production of Trad. Oilseeds, Kharif
184	PS3NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
185	PS3PUK	Small Farm Production of Pulses, Kharif
186	PS3VEK	Small Farm Production of Vegetables, Kharif
187	PS3FDK	Small Farm Production of Fodder, Kharif
188	PS3WHE	Small Farm Production of Wheat
189	PS3WHB	Small Farm Production of Late Wheat

Row	Name	Description
190	PS3BAR	Small Farm Production of Barley
191	PS3PUR	Small Farm Production of Pulses, Rabi
192	PS3HVA	Small Farm Production of Vegetables, Rabi
193	PS3TOR	Small Farm Production of Trad. Oilseeds, Rabi
194	PS3NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
195	PS3FDR	Small Farm Production of Fodder, Rabi
196	PS3FRU	Small Farm Production of Fruit
		Production in Punjab Cotton Zone
		Medium Farms
197	PM3RIB	Medium Farm Production of Basmati Rice
198	PM3RIO	Medium Farm Production of Other Rice
199	PM3COG	Medium Farm Production of Coarse Grain
200	PM3CO3	Medium Farm Production of Three-Picking Cotton
201	PM3CO4	Medium Farm Production of Four-Picking Cotton
202	PM3SUG	Medium Farm Production of Sugar
203	PM3TOK	Medium Farm Production of Trad. Oilseeds, Kharif
204	PM3NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
205	PM3PUK	Medium Farm Production of Pulses, Kharif
206	PM3VEK	Medium Farm Production of Vegetables, Kharif
207	PM3FDK	Medium Farm Production of Fodder, Kharif
208	PM3WHE	Medium Farm Production of Wheat
209	PM3WHB	Medium Farm Production of Late Wheat
210	PM3BAR	Medium Farm Production of Barley
211	PM3PUR	Medium Farm Production of Pulses, Rabi
212	PM3HVA	Medium Farm Production of Vegetables, Rabi
213	PM3TOR	Medium Farm Production of Trad. Oilseeds, Rabi
214	PM3NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
215	PM3FDR	Medium Farm Production of Fodder, Rabi
216	PM3FRU	Medium Farm Production of Fruit
		Production in Punjab Cotton Zone
		Large Farms
217	PL3RIB	Large Farm Production of Basmati Rice
218	PL3RIO	Large Farm Production of Other Rice
219	PL3COG	Large Farm Production of Coarse Grain
220	PL3CO3	Large Farm Production of Three-Picking Cotton
221	PL3CO4	Large Farm Production of Four-Picking Cotton
222	PL3SUG	Large Farm Production of Sugar
223	PL3TOK	Large Farm Production of Trad. Oilseeds, Kharif
224	PL3NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
225	PL3PUK	Large Farm Production of Pulses, Kharif
226	PL3VEK	Large Farm Production of Vegetables, Kharif
227	PL3FDK	Large Farm Production of Fodder, Kharif
228	PL3WHE	Large Farm Production of Wheat
229	PL3WHB	Large Farm Production of Late Wheat
230	PL3BAR	Large Farm Production of Barley
231	PL3PUR	Large Farm Production of Pulses, Rabi
232	PL3HVA	Large Farm Production of Vegetables, Rabi
233	PL3TOR	Large Farm Production of Trad. Oilseeds, Rabi
234	PL3NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
235	PL3FDR	Large Farm Production of Fodder, Rabi
236	PL3FRU	Large Farm Production of Fruit
		Punjab Cotton Zone
		Livestock Maintenance Activities
237	L3MCA1	Milking Cows/Buffaloes Maintained on Ration 1
238	L3MCA2	Milking Cows/Buffaloes Maintained on Ration 2

Row	Name	Description
239	L3MCA3	Milking Cows/Buffaloes Maintained on Ration 3
240	L3NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
241	L3NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
242	L3NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
243	L3GOS1	Goats and Sheep Maintained on Ration 1
244	L3GOS2	Goats and Sheep Maintained on Ration 2
245	L3GOS3	Goats and Sheep Maintained on Ration 3
246	L3BRO1	Broilers Maintained on Ration 1
247	L3BRO2	Broilers Maintained on Ration 2
248	L3BRO3	Broilers Maintained on Ration 3
249	L3BRO4	Broilers Maintained on Ration 4
250	L3LAY1	Layers Maintained on Ration 1
251	L3LAY2	Layers Maintained on Ration 2
252	L3LAY3	Layers Maintained on Ration 3
253	L3LAY4	Layers Maintained on Ration 4
254	L3DESI	Desi Chicken Ration
		Punjab Cotton Zone
		Household Purchases of Basic Commodities
255	HS3WHE	Small Farms' Household Purchases of Wheat
256	HS3RIC	Small Farms' Household Purchases of Rice
257	HM3WHE	Medium Farms' Household Purchases of Wheat
258	HM3RIC	Medium Farms' Household Purchases of Rice
259	HL3WHE	Large Farms' Household Purchases of Wheat
260	HL3RIC	Large Farms' Household Purchases of Rice
		Punjab Cotton Zone
		Input Balances
261	IB3CAK	Input Balance for Canal Water, Kharif
262	IB3CAR	Input Balance for Canal Water, Rabi
263	IB3TUK	Input Balance for Tubewell Water, Karif
264	IB3TUR	Input Balance for Tubewell Water, Rabi
		Accounting Rows for Priced Inputs, Punjab
265	A1FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 1
266	A1FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 1
267	A1FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 1
268	A1FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 1
269	A1FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 1
270	A1FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 1
271	A2FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 2
272	A2FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 2
273	A2FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 2
274	A2FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 2
275	A2FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 2
276	A2FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 2
277	A3FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 3
278	A3FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 3
279	A3FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 3
280	A3FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 3
281	A3FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 3
282	A3FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 3
283	APUHLK	Total Usage of Hired Labor, Kharif, All Punjab Region
284	APUHLR	Total Usage of Hired Labor, Rabi, All Punjab Region

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Row	Name	Description
		Punjab Regional
		Input Balances
285	IPUFEN	Regional Input Balance for Nitrogen Fertilizer
286	IPUFEP	Regional Input Balance for Phosphatic Fertilizer
287	IPUFEK	Regional Input Balance for Potash Fertilizer
288	IPUHL	Regional Input Balance for Hired Labor
289	IPUTTR	Regional Input Balance for Tractor Services
		Punjab Regional
		Domestic Marketing
290	MPURIB	Domestic Marketing from Punjab of Basmati Rice
291	MPURIO	Domestic Marketing from Punjab of Other Rice
292	MPUCOG	Domestic Marketing from Punjab of Coarse Grains
293	MPUCOT	Domestic Marketing from Punjab of Cotton
294	MPUSUG	Domestic Marketing from Punjab of Sugar
295	MPUTOL	Domestic Marketing from Punjab of Trad. Oilseeds
296	MPUNOK	Domestic Marketing from Punjab of Non-trad. Oilseeds, Kharif
297	MPUPUL	Domestic Marketing from Punjab of All Pulses
298	MPUVEG	Domestic Marketing from Punjab of All Vegetables
299	MPUWHE	Domestic Marketing from Punjab of Wheat
300	MPUNOR	Domestic Marketing from Punjab of Non-trad. Oilseeds, Rabi
301	MPUFRU	Domestic Marketing from Punjab of Fruit
302	MPUNMC	Domestic Marketing from Punjab of Beef
303	MPUMCA	Domestic Marketing from Punjab of Milk
304	MPUBUT	Domestic Marketing from Punjab of Butter
305	MPUAGE	Domestic Marketing from Punjab of Animal Ghee
306	MPUGOS	Domestic Marketing from Punjab of Goats and Sheep
307	MPUPOU	Domestic Marketing from Punjab of Poultry
308	MPUEGG	Domestic Marketing from Punjab of Eggs
		Punjab Region Exports
309	MXPRIB	Export Marketing from Punjab of Basmati Rice
310	MXPRIO	Export Marketing from Punjab of Other Rice
311	MXPCTF	Export Marketing from Punjab of Cotton Fiber
312	MXPVEG	Export Marketing from Punjab of All Vegetables
313	MXPFRU	Export Marketing from Punjab of Fruit
		SIND RICE ZONE
		Production in Sind Rice Zone
		Small Farms
314	PS4RIO	Small Farm Production of Other Rice
315	PS4COG	Small Farm Production of Coarse Grain
316	PS4CO3	Small Farm Production of Three-Picking Cotton
317	PS4CO4	Small Farm Production of Four-Picking Cotton
318	PS4SUG	Small Farm Production of Sugar
319	PS4TOK	Small Farm Production of Trad. Oilseeds, Kharif
320	PS4NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
321	PS4PUK	Small Farm Production of Pulses, Kharif
322	PS4VEK	Small Farm Production of Vegetables, Kharif
323	PS4FDK	Small Farm Production of Fodder, Kharif
324	PS4WHE	Small Farm Production of Wheat
325	PS4WHL	Small Farm Production of Late Wheat
326	PS4BAR	Small Farm Production of Barley
327	PS4PUR	Small Farm Production of Pulses, Rabi
328	PS4HVA	Small Farm Production of Vegetables, Rabi
329	PS4TOR	Small Farm Production of Trad. Oilseeds, Rabi

Row	Name	Description
330	PS4NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
331	PS4FDR	Small Farm Production of Fodder, Rabi
332	PS4FRU	Small Farm Production of Fruit
		Production in Sind Rice Zone
		Medium Farms
333	PM4RIO	Medium Farm Production of Other Rice
334	PM4COG	Medium Farm Production of Coarse Grain
335	PM4CO3	Medium Farm Production of Three-Picking Cotton
336	PM4CO4	Medium Farm Production of Four-Picking Cotton
337	PM4SUG	Medium Farm Production of Sugar
338	PM4TOK	Medium Farm Production of Trad. Oilseeds, Kharif
339	PM4NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
340	PM4PUK	Medium Farm Production of Pulses, Kharif
341	PM4VEK	Medium Farm Production of Vegetables, Kharif
342	PM4FDK	Medium Farm Production of Fodder, Kharif
343	PM4WHE	Medium Farm Production of Wheat
344	PM4WHL	Medium Farm Production of Late Wheat
345	PM4BAR	Medium Farm Production of Barley
346	PM4PUR	Medium Farm Production of Pulses, Rabi
347	PM4HVA	Medium Farm Production of Vegetables, Rabi
348	PM4TOR	Medium Farm Production of Trad. Oilseeds, Rabi
349	PM4NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
350	PM4FDR	Medium Farm Production of Fodder, Rabi
351	PM4FRU	Medium Farm Production of Fruit
		Production in Sind Rice Zone
		Large Farms
352	PL4RIO	Large Farm Production of Other Rice
353	PL4COG	Large Farm Production of Coarse Grain
354	PL4CO3	Large Farm Production of Three-Picking Cotton
355	PL4CO4	Large Farm Production of Four-Picking Cotton
356	PL4SUG	Large Farm Production of Sugar
357	PL4TOK	Large Farm Production of Trad. Oilseeds, Kharif
358	PL4NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
359	PL4PUK	Large Farm Production of Pulses, Kharif
360	PL4VEK	Large Farm Production of Vegetables, Kharif
361	PL4FDK	Large Farm Production of Fodder, Kharif
362	PL4WHE	Large Farm Production of Wheat
363	PL4WHL	Large Farm Production of Late Wheat
364	PL4BAR	Large Farm Production of Barley
365	PL4PUR	Large Farm Production of Pulses, Rabi
366	PL4HVA	Large Farm Production of Vegetables, Rabi
367	PL4TOR	Large Farm Production of Trad. Oilseeds, Rabi
368	PL4NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
369	PL4FDR	Large Farm Production of Fodder, Rabi
370	PL4FRU	Large Farm Production of Fruit
		Sind Rice Zone
		Livestock Maintenance Activities
371	L4MCA1	Milking Cows/Buffaloes Maintained on Ration 1
372	L4MCA2	Milking Cows/Buffaloes Maintained on Ration 2
373	L4MCA3	Milking Cows/Buffaloes Maintained on Ration 3
374	L4NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
375	L4NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
376	L4NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
377	L4GOS1	Goats and Sheep Maintained on Ration 1
378	L4GOS2	Goats and Sheep Maintained on Ration 2

Row	Name	Description
379	L4GOS3	Goats and Sheep Maintained on Ration 3
380	L4BRO1	Broilers Maintained on Ration 1
381	L4BRO2	Broilers Maintained on Ration 2
382	L4BRO3	Broilers Maintained on Ration 3
383	L4BRO4	Broilers Maintained on Ration 4
384	L4LAY1	Layers Maintained on Ration 1
385	L4LAY2	Layers Maintained on Ration 2
386	L4LAY3	Layers Maintained on Ration 3
387	L4LAY4	Layers Maintained on Ration 4
388	L4DESI	Desi Chicken Ration
		Sind Rice Zone
		Household Purchases
389	HS4WHE	Small Farms' Household Purchases of Wheat
390	HS4RIC	Small Farms' Household Purchases of Rice
391	HM4WHE	Medium Farms' Household Purchases of Wheat
392	HM4RIC	Medium Farms' Household Purchases of Rice
393	HL4WHE	Large Farms' Household Purchases of Wheat
394	HL4RIC	Large Farms' Household Purchases of Rice
		Sind Rice Zone
		Input Balances
395	IB4CAK	Input Balance for Canal Water, Kharif
396	IB4CAR	Input Balance for Canal Water, Rabi
397	IB4TUK	Input Balance for Tubewell Water, Karif
398	IB4TUR	Input Balance for Tubewell Water, Rabi
		SIND COTTON ZONE
		Production in Sind Cotton Zone
		Small Farms
399	PS5RIO	Small Farm Production of Other Rice
400	PS5COG	Small Farm Production of Coarse Grain
401	PS5CO3	Small Farm Production of Three-Picking Cotton
402	PS5CO4	Small Farm Production of Four-Picking Cotton
403	PS5SUG	Small Farm Production of Sugar
404	PS5TOK	Small Farm Production of Trad. Oilseeds, Kharif
405	PS5NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
406	PS5PUK	Small Farm Production of Pulses, Kharif
407	PS5VEK	Small Farm Production of Vegetables, Kharif
408	PS5FDK	Small Farm Production of Fodder, Kharif
409	PS5WHE	Small Farm Production of Wheat
410	PS5WHL	Small Farm Production of Late Wheat
411	PS5BAR	Small Farm Production of Barley
412	PS5PUR	Small Farm Production of Pulses, Rabi
413	PS5HVA	Small Farm Production of Vegetables, Rabi
414	PS5TOR	Small Farm Production of Trad. Oilseeds, Rabi
415	PS5NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
416	PS5FDR	Small Farm Production of Fodder, Rabi
417	PS5FRU	Small Farm Production of Fruit
		Production in Sind Cotton Zone
		Medium Farms
418	PM5RIO	Medium Farm Production of Other Rice
419	PM5COG	Medium Farm Production of Coarse Grain
420	PM5CO3	Medium Farm Production of Three-Picking Cotton

Row	Name	Description
421	PM5CO4	Medium Farm Production of Four-Picking Cotton
422	PM5SUG	Medium Farm Production of Sugar
423	PM5TOK	Medium Farm Production of Trad. Oilseeds, Kharif
424	PM5NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
425	PM5PUK	Medium Farm Production of Pulses, Kharif
426	PM5VEK	Medium Farm Production of Vegetables, Kharif
427	PM5FDK	Medium Farm Production of Fodder, Kharif
428	PM5WHE	Medium Farm Production of Wheat
429	PM5WHL	Medium Farm Production of Late Wheat
430	PM5BAR	Medium Farm Production of Barley
431	PM5PUR	Medium Farm Production of Pulses, Rabi
432	PM5HVA	Medium Farm Production of Vegetables, Rabi
433	PM5TOR	Medium Farm Production of Trad. Oilseeds, Rabi
434	PM5NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
435	PM5FDR	Medium Farm Production of Fodder, Rabi
436	PM5FRU	Medium Farm Production of Fruit
		Production in Sind Cotton Zone
		Large Farms
437	PL5RIO	Large Farm Production of Other Rice
438	PL5COG	Large Farm Production of Coarse Grain
439	PL5CO3	Large Farm Production of Three-Picking Cotton
440	PL5CO4	Large Farm Production of Four-Picking Cotton
441	PL5SUG	Large Farm Production of Sugar
442	PL5TOK	Large Farm Production of Trad. Oilseeds, Kharif
443	PL5NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
444	PL5PUK	Large Farm Production of Pulses, Kharif
445	PL5VEK	Large Farm Production of Vegetables, Kharif
446	PL5FDK	Large Farm Production of Fodder, Kharif
447	PL5WHE	Large Farm Production of Wheat
448	PL5WHL	Large Farm Production of Late Wheat
449	PL5BAR	Large Farm Production of Barley
450	PL5PUR	Large Farm Production of Pulses, Rabi
451	PL5HVA	Large Farm Production of Vegetables, Rabi
452	PL5TOR	Large Farm Production of Trad. Oilseeds, Rabi
453	PL5NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
454	PL5FDR	Large Farm Production of Fodder, Rabi
455	PL5FRU	Large Farm Production of Fruit
		Sind Cotton Zone
		Livestock
456	L5MCA1	Milking Cows/Buffaloes Maintained on Ration 1
457	L5MCA2	Milking Cows/Buffaloes Maintained on Ration 2
458	L5MCA3	Milking Cows/Buffaloes Maintained on Ration 3
459	L5NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
460	L5NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
461	L5NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
462	L5GOS1	Goats and Sheep Maintained on Ration 1
463	L5GOS2	Goats and Sheep Maintained on Ration 2
464	L5GOS3	Goats and Sheep Maintained on Ration 3
465	L4BRO1	Broilers Maintained on Ration 1
466	L5BRO2	Broilers Maintained on Ration 2
467	L5BRO3	Broilers Maintained on Ration 3
468	L5BRO4	Broilers Maintained on Ration 4
469	L5LAY1	Layers Maintained on Ration 1
470	L5LAY2	Layers Maintained on Ration 2
471	L5LAY3	Layers Maintained on Ration 3
472	L5LAY4	Layers Maintained on Ration 4
473	L5DESI	Desi Chicken Ration

Row	Name	Description
		Sind Cotton Zone
		Household Purchases of Basic Commodities
474	HS5WHE	Small Farms' Household Purchases of Wheat
475	HS5RIC	Small Farms' Household Purchases of Rice
476	HM5WHE	Medium Farms' Household Purchases of Wheat
477	HM5RIC	Medium Farms' Household Purchases of Rice
478	HL5WHE	Large Farms' Household Purchases of Wheat
479	HL5RIC	Large Farms' Household Purchases of Rice
		Sind Cotton Zone
		Input Balances
480	IB5CAK	Input Balance for Canal Water, Kharif
481	IB5CAR	Input Balance for Canal Water, Rabi
482	IB5TUK	Input Balance for Tubewell Water, Karif
483	IB5TUR	Input Balance for Tubewell Water, Rabi
		Accounting Rows for Priced Inputs, Sind Region
484	A4FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 4
485	A4FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 4
486	A4FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 4
487	A4FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 4
488	A4FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 4
489	A4FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 4
490	A5FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 5
491	A5FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 5
492	A5FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 5
493	A5FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 5
494	A5FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 5
495	A5FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 5
496	ASIHLK	Total Usage of Hired Labor, Kharif, All Sind Region
497	ASIHLR	Total Usage of Hired Labor, Rabi, All Sind Region
		Sind Regional
		Input Balances
498	ISIFEN	Regional Input Balance for Nitrogen Fertilizer
499	ISIFEP	Regional Input Balance for Phosphatic Fertilizer
500	ISIFEK	Regional Input Balance for Potash Fertilizer
501	ISIHL	Regional Input Balance for Hired Labor
502	ISITTR	Regional Input Balance for Tractor Services
		Sind Region
		Domestic Marketing
503	MSIRIO	Domestic Marketing from Punjab of Other Rice
504	MSICOG	Domestic Marketing from Punjab of Coarse Grains
505	MSICTF	Domestic Marketing from Punjab of Cotton Fiber
506	MSISUG	Domestic Marketing from Punjab of Sugar
507	MSITOL	Domestic Marketing from Punjab of Trad. Oilseeds
508	MSINOK	Domestic Marketing from Punjab of Non-trad. Oilseeds, Kharif
509	MSIPUL	Domestic Marketing from Punjab of All Pulses
510	MSIVEG	Domestic Marketing from Punjab of All Vegetables
511	MSIWHE	Domestic Marketing from Punjab of Wheat
512	MSINOR	Domestic Marketing from Punjab of Non-trad. Oilseeds, Rabi
513	MSIFRU	Domestic Marketing from Punjab of Fruit
514	MSINMC	Domestic Marketing from Punjab Beef
515	MSIMCA	Domestic Marketing from Punjab of Milk
516	MSIBUT	Domestic Marketing from Punjab of Butter

Row	Name	Description
517	MSIAGE	Domestic Marketing from Punjab of Animal Ghee
518	MSIGOS	Domestic Marketing from Punjab of Goats and Sheep
519	MSIPOU	Domestic Marketing from Punjab of Poultry
520	MSIEGG	Domestic Marketing from Punjab of Eggs
		Sind Region
		Export Marketing
521	MXSRIO	Export Marketing from Sind of Other Rice
522	MXSCTF	Export Marketing from Sind of Cotton Fiber Products
523	MXSVEG	Export Marketing from Sind of All Vegetables
524	MXSFRU	Export Marketing from Sind of Fruit
		BALUCHISTAN
		Production in Baluchistan
		Small Farms
525	PS6RIB	Small Farm Production of Basmati Rice
526	PS6RIO	Small Farm Production of Other Rice
527	PS6COG	Small Farm Production of Coarse Grain
528	PS6SUG	Small Farm Production of Sugar
529	PS6TOK	Small Farm Production of Trad. Oilseeds, Kharif
530	PS6PUK	Small Farm Production of Pulses, Kharif
531	PS6VEK	Small Farm Production of Vegetables, Kharif
532	PS6FDK	Small Farm Production of Fodder, Kharif
533	PS6WHE	Small Farm Production of Wheat
534	PS6WHL	Small Farm Production of Late Wheat
535	PS6BAR	Small Farm Production of Barley
536	PS6PUR	Small Farm Production of Pulses, Rabi
537	PS6HVA	Small Farm Production of Vegetables, Rabi
538	PS6TOR	Small Farm Production of Trad. Oilseeds, Rabi
539	PS6FDR	Small Farm Production of Fodder, Rabi
540	PS6FRU	Small Farm Production of Fruit
		Production in Baluchistan
		Medium Farms
541	PM6RIB	Medium Farm Production of Basmati Rice
542	PM6RIO	Medium Farm Production of Other Rice
543	PM6COG	Medium Farm Production of Coarse Grain
544	PM6SUG	Medium Farm Production of Sugar
545	PM6TOK	Medium Farm Production of Trad. Oilseeds, Kharif
546	PM6PUK	Medium Farm Production of Pulses, Kharif
547	PM6VEK	Medium Farm Production of Vegetables, Kharif
548	PM6FDK	Medium Farm Production of Fodder, Kharif
549	PM6WHE	Medium Farm Production of Wheat
550	PM6WHL	Medium Farm Production of Late Wheat
551	PM6BAR	Medium Farm Production of Barley
552	PM6PUR	Medium Farm Production of Pulses, Rabi
553	PM6HVA	Medium Farm Production of Vegetables, Rabi
554	PM6TOR	Medium Farm Production of Trad. Oilseeds, Rabi
555	PM6FDR	Medium Farm Production of Fodder, Rabi
556	PM6FRU	Medium Farm Production of Fruit
		Production in Baluchistan
		Large Farms
557	PL6RIB	Large Farm Production of Basmati Rice
558	PL6RIO	Large Farm Production of Other Rice

Row	Name	Description
559	PL6COG	Large Farm Production of Coarse Grain
560	PL6SUG	Large Farm Production of Sugar
561	PL6TOK	Large Farm Production of Trad. Oilseeds, Kharif
562	PL6PUK	Large Farm Production of Pulses, Kharif
563	PL6VEK	Large Farm Production of Vegetables, Kharif
564	PL6FDK	Large Farm Production of Fodder, Kharif
565	PL6WHE	Large Farm Production of Wheat
566	PL6WHL	Large Farm Production of Late Wheat
567	PL6BAR	Large Farm Production of Barley
568	PL6PUR	Large Farm Production of Pulses, Rabi
569	PL6HVA	Large Farm Production of Vegetables, Rabi
570	PL6TOR	Large Farm Production of Trad. Oilseeds, Rabi
571	PL6FDR	Large Farm Production of Fodder, Rabi
572	PL6FRU	Large Farm Production of Fruit
		Baluchistan
		Livestock Maintenance Activities
573	L6MCA1	Milking Cows/Buffaloes Maintained on Ration 1
574	L6MCA2	Milking Cows/Buffaloes Maintained on Ration 2
575	L6MCA3	Milking Cows/Buffaloes Maintained on Ration 3
576	L6NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
577	L6NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
578	L6NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
579	L6GOS1	Goats and Sheep Maintained on Ration 1
580	L6GOS2	Goats and Sheep Maintained on Ration 2
581	L6GOS3	Goats and Sheep Maintained on Ration 3
582	L6BRO1	Broilers Maintained on Ration 1
583	L6BRO2	Broilers Maintained on Ration 2
584	L6BRO3	Broilers Maintained on Ration 3
585	L6BRO4	Broilers Maintained on Ration 4
586	L6LAY1	Layers Maintained on Ration 1
587	L6LAY2	Layers Maintained on Ration 2
588	L6LAY3	Layers Maintained on Ration 3
589	L6LAY4	Layers Maintained on Ration 4
590	L6DESI	Desi Chicken Ration
		Baluchistan
		Household Purchases of Basic Commodities
591	HS6WHE	Small Farms' Household Purchases of Wheat
592	HS6RIC	Small Farms' Household Purchases of Rice
593	HM6WHE	Medium Farms' Household Purchases of Wheat
594	HM6RIC	Medium Farms' Household Purchases of Rice
595	HL6WHE	Large Farms' Household Purchases of Wheat
596	HL6RIC	Large Farms' Household Purchases of Rice
		Baluchistan
		Input Balance
597	IB6CAK	Input Balance for Canal Water, Kharif
598	IB6CAR	Input Balance for Canal Water, Rabi
599	IB6TUK	Input Balance for Tubewell Water, Karif
600	IB6TUR	Input Balance for Tubewell Water, Rabi
		Accounting Rows for Priced Inputs, Baluchistan Region
601	A6FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 6
602	A6FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 6
603	A6FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 6
604	A6FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 6

Row	Name	Description
605	A6FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 6
606	A6FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 6
607	ABAHLK	Total Usage of Hired Labor, Kharif, All Baluchistan
608	ABAHLR	Total Usage of Hired Labor, Rabi, All Baluchistan
		Baluchistan
		Regional Input Balances
609	IBAFEN	Regional Input Balance for Nitrogen Fertilizer
610	IBAFEP	Regional Input Balance for Phosphatic Fertilizer
611	IBAFEK	Regional Input Balance for Potash Fertilizer
612	IBAHL	Regional Input Balance for Hired Labor
613	IBATTR	Regional Input Balance for Tractor Services
		Baluchistan
		Domestic Marketing
614	MBARIB	Domestic Marketing from Baluchistan of Basmati Rice
615	MBARIO	Domestic Marketing from Baluchistan of Other Rice
616	MBACOG	Domestic Marketing from Baluchistan of Coarse Grains
617	MBASUG	Domestic Marketing from Baluchistan of Sugar
618	MBATOL	Domestic Marketing from Baluchistan of Trad. Oilseeds
619	MBAPUL	Domestic Marketing from Baluchistan of All Pulses
620	MBAVEG	Domestic Marketing from Baluchistan of All Vegetables
621	MBAWHE	Domestic Marketing from Baluchistan of Wheat
622	MBAFRU	Domestic Marketing from Baluchistan of Fruit
623	MBANMC	Domestic Marketing from Baluchistan of Beef
624	MBAMCA	Domestic Marketing from Baluchistan of Milk
625	MBABUT	Domestic Marketing from Baluchistan of Butter
626	MBAAGE	Domestic Marketing from Baluchistan of Animal Ghee
627	MBAGOS	Domestic Marketing from Baluchistan of Goats and Sheep
628	MBAPOU	Domestic Marketing from Baluchistan of Poultry
629	MBAEGG	Domestic Marketing from Baluchistan of Eggs
		Baluchistan
		Export Marketing
630	MXBVEG	Export Marketing from Baluchistan of Vegetables
631	MXBFRU	Export Marketing from Baluchistan of Fruit
		NWFP
		Production in NWFP (Irrigated)
		Small Farms
632	PS7RIB	Small Farm Production of Basmati Rice
633	PS7RIO	Small Farm Production of Other Rice
634	PS7COG	Small Farm Production of Coarse Grain
635	PS7COT	Small Farm Production of Cotton
636	PS7SUG	Small Farm Production of Sugar
637	PS7TOK	Small Farm Production of Trad. Oilseeds, Kharif
638	PS7NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
639	PS7PUK	Small Farm Production of Pulses, Kharif
640	PS7VEK	Small Farm Production of Vegetables, Kharif
641	PS7FDK	Small Farm Production of Fodder, Kharif
642	PS7WHE	Small Farm Production of Wheat
643	PS7WHL	Small Farm Production of Late Wheat
644	PS7BAR	Small Farm Production of Barley
645	PS7PUR	Small Farm Production of Pulses, Rabi
646	PS7HVA	Small Farm Production of Vegetables, Rabi

Row	Name	Description
647	PS7TOR	Small Farm Production of Trad. Oilseeds, Rabi
648	PS7NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
649	PS7FDR	Small Farm Production of Fodder, Rabi
650	PS7FRU	Small Farm Production of Fruit
		Production in NWFP (Unirrigated)
		Small Farms
651	PS8RIB	Small Farm Production of Basmati Rice
652	PS8RIO	Small Farm Production of Other Rice
653	PS8COG	Small Farm Production of Coarse Grain
654	PS8COT	Small Farm Production of Cotton
655	PS8SUG	Small Farm Production of Sugar
656	PS8TOK	Small Farm Production of Trad. Oilseeds, Kharif
657	PS8NOK	Small Farm Production of Non-trad. Oilseeds, Kharif
658	PS8PUK	Small Farm Production of Pulses, Kharif
659	PS8VEK	Small Farm Production of Vegetables, Kharif
660	PS8FDK	Small Farm Production of Fodder, Kharif
661	PS8WHE	Small Farm Production of Wheat
662	PS8WHL	Small Farm Production of Late Wheat
663	PS8BAR	Small Farm Production of Barley
664	PS8PUR	Small Farm Production of Pulses, Rabi
665	PS8HVA	Small Farm Production of Vegetables, Rabi
666	PS8TOR	Small Farm Production of Trad. Oilseeds, Rabi
667	PS8NOR	Small Farm Production of Non-trad. Oilseeds, Rabi
668	PS8FDR	Small Farm Production of Fodder, Rabi
669	PS8FRU	Small Farm Production of Fruit
		Production in NWFP (Irrigated)
		Medium Farms
670	PM7RIB	Medium Farm Production of Basmati Rice
671	PM7RIO	Medium Farm Production of Other Rice
672	PM7COG	Medium Farm Production of Coarse Grain
673	PM7COT	Medium Farm Production of Cotton
674	PM7SUG	Medium Farm Production of Sugar
675	PM7TOK	Medium Farm Production of Trad. Oilseeds, Kharif
676	PM7NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif
677	PM7PUK	Medium Farm Production of Pulses, Kharif
678	PM7VEK	Medium Farm Production of Vegetables, Kharif
679	PM7FDK	Medium Farm Production of Fodder, Kharif
680	PM7WHE	Medium Farm Production of Wheat
681	PM7WHL	Medium Farm Production of Late Wheat
682	PM7BAR	Medium Farm Production of Barley
683	PM7PUR	Medium Farm Production of Pulses, Rabi
684	PM7HVA	Medium Farm Production of Vegetables, Rabi
685	PM7TOR	Medium Farm Production of Trad. Oilseeds, Rabi
686	PM7NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
687	PM7FDR	Medium Farm Production of Fodder, Rabi
688	PM7FRU	Medium Farm Production of Fruit
		Production in NWFP (Unirrigated)
		Medium Farms
689	PM8RIB	Medium Farm Production of Basmati Rice
690	PM8RIO	Medium Farm Production of Other Rice
691	PM8COG	Medium Farm Production of Coarse Grain
692	PM8COT	Medium Farm Production of Cotton
693	PM8SUG	Medium Farm Production of Sugar
694	PM8TOK	Medium Farm Production of Trad. Oilseeds, Kharif
695	PM8NOK	Medium Farm Production of Non-trad. Oilseeds, Kharif

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Row	Name	Description
696	PM8PUK	Medium Farm Production of Pulses, Kharif
697	PM8VEK	Medium Farm Production of Vegetables, Kharif
698	PM8FDK	Medium Farm Production of Fodder, Kharif
699	PM8WHE	Medium Farm Production of Wheat
700	PM8WHL	Medium Farm Production of Late Wheat
701	PM8BAR	Medium Farm Production of Barley
702	PM8PUR	Medium Farm Production of Pulses, Rabi
703	PM8HVA	Medium Farm Production of Vegetables, Rabi
704	PM8TOR	Medium Farm Production of Trad. Oilseeds, Rabi
705	PM8NOR	Medium Farm Production of Non-trad. Oilseeds, Rabi
706	PM8FDR	Medium Farm Production of Fodder, Rabi
707	PM8FRU	Medium Farm Production of Fruit
		Production in NWFP (Irrigated)
		Large Farms
708	PL7RIB	Large Farm Production of Basmati Rice
709	PL7RIO	Large Farm Production of Other Rice
710	PL7COG	Large Farm Production of Coarse Grain
711	PL7COT	Large Farm Production of Cotton
712	PL7SUG	Large Farm Production of Sugar
713	PL7TOK	Large Farm Production of Trad. Oilseeds, Kharif
714	PL7NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
715	PL7PUK	Large Farm Production of Pulses, Kharif
716	PL7VEK	Large Farm Production of Vegetables, Kharif
717	PL7FDK	Large Farm Production of Fodder, Kharif
718	PL7WHE	Large Farm Production of Wheat
719	PL7WHL	Large Farm Production of Late Wheat
720	PL7BAR	Large Farm Production of Barley
721	PL7PUR	Large Farm Production of Pulses, Rabi
722	PL7HVA	Large Farm Production of Vegetables, Rabi
723	PL7TOR	Large Farm Production of Trad. Oilseeds, Rabi
724	PL7NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
725	PL7FDR	Large Farm Production of Fodder, Rabi
726	PL7FRU	Large Farm Production of Fruit
		Production in NWFP (Unirrigated)
		Large Farms
727	PL8RIB	Large Farm Production of Basmati Rice
728	PL8RIO	Large Farm Production of Other Rice
729	PL8COG	Large Farm Production of Coarse Grain
730	PL8COT	Large Farm Production of Cotton
731	PL8SUG	Large Farm Production of Sugar
732	PL8TOK	Large Farm Production of Trad. Oilseeds, Kharif
733	PL8NOK	Large Farm Production of Non-trad. Oilseeds, Kharif
734	PL8PUK	Large Farm Production of Pulses, Kharif
735	PL8VEK	Large Farm Production of Vegetables, Kharif
736	PL8FDK	Large Farm Production of Fodder, Kharif
737	PL8WHE	Large Farm Production of Wheat
738	PL8WHL	Large Farm Production of Late Wheat
739	PL8BAR	Large Farm Production of Barley
740	PL8PUR	Large Farm Production of Pulses, Rabi
741	PL8HVA	Large Farm Production of Vegetables, Rabi
742	PL8TOR	Large Farm Production of Trad. Oilseeds, Rabi
743	PL8NOR	Large Farm Production of Non-trad. Oilseeds, Rabi
744	PL8FDR	Large Farm Production of Fodder, Rabi
745	PL8FRU	Large Farm Production of Fruit

Row	Name	Description
		NWFP Irrigated
		Livestock Maintenance Activities
746	L7MCA1	Milking Cows/Buffaloes Maintained on Ration 1
747	L7MCA2	Milking Cows/Buffaloes Maintained on Ration 2
748	L7MCA3	Milking Cows/Buffaloes Maintained on Ration 3
749	L7NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
750	L7NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
751	L7NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
752	L7GOS1	Goats and Sheep Maintained on Ration 1
753	L7GOS2	Goats and Sheep Maintained on Ration 2
754	L7GOS3	Goats and Sheep Maintained on Ration 3
755	L7BRO1	Broilers Maintained on Ration 1
756	L7BRO2	Broilers Maintained on Ration 2
757	L7BRO3	Broilers Maintained on Ration 3
758	L7BRO4	Broilers Maintained on Ration 4
759	L7LAY1	Layers Maintained on Ration 1
760	L7LAY2	Layers Maintained on Ration 2
761	L7LAY3	Layers Maintained on Ration 3
762	L7LAY4	Layers Maintained on Ration 4
763	L7DESI	Desi Chicken Ration
		NWFP Irrigated
		Livestock Maintenance Activities
764	L8MCA1	Milking Cows/Buffaloes Maintained on Ration 1
765	L8MCA2	Milking Cows/Buffaloes Maintained on Ration 2
766	L8MCA3	Milking Cows/Buffaloes Maintained on Ration 3
767	L8NMC1	Non-Milking Cows/Buffaloes Maintained on Ration 1
768	L8NMC2	Non-Milking Cows/Buffaloes Maintained on Ration 2
769	L8NMC3	Non-Milking Cows/Buffaloes Maintained on Ration 3
770	L8GOS1	Goats and Sheep Maintained on Ration 1
771	L8GOS2	Goats and Sheep Maintained on Ration 2
772	L8GOS3	Goats and Sheep Maintained on Ration 3
773	L8BRO1	Broilers Maintained on Ration 1
774	L8BRO2	Broilers Maintained on Ration 2
775	L8BRO3	Broilers Maintained on Ration 3
776	L8BRO4	Broilers Maintained on Ration 4
777	L8LAY1	Layers Maintained on Ration 1
778	L8LAY2	Layers Maintained on Ration 2
779	L8LAY3	Layers Maintained on Ration 3
780	L8LAY4	Layers Maintained on Ration 4
781	L8DESI	Desi Chicken Ration
		NWFP Irrigated
		Household Purchases of Basic Commodities
782	HS7WHE	Small Farms' Household Purchases of Wheat
783	HS7RIC	Small Farms' Household Purchases of Rice
784	HM7WHE	Medium Farms' Household Purchases of Wheat
785	HM7RIC	Medium Farms' Household Purchases of Rice
786	HL7WHE	Large Farms' Household Purchases of Wheat
787	HL7RIC	Large Farms' Household Purchases of Rice
		NWFP Irrigated
		Input Balances
788	IB7CAK	Input Balance for Canal Water, Kharif
789	IB7CAR	Input Balance for Canal Water, Rabi
790	IB7TUK	Input Balance for Tubewell Water, Karif
791	IB7TUR	Input Balance for Tubewell Water, Rabi

Row	Name	Description
		Accounting Rows for Priced Inputs, NWFP Region
792	A7FENK	Total Usage of Nitrogen Fertilizer, Kharif, Zone 7
793	A7FEPK	Total Usage of Phosphatic Fertilizer, Kharif, Zone 7
794	A7FEKK	Total Usage of Potash Fertilizer, Kharif, Zone 7
795	A7FENR	Total Usage of Nitrogen Fertilizer, Rabi, Zone 7
796	A7FEPR	Total Usage of Phosphatic Fertilizer, Rabi, Zone 7
797	A7FEKR	Total Usage of Potash Fertilizer, Rabi, Zone 7
798	ANPHLK	Total Usage of Hired Labor, Kharif, All NWFP
799	ANPHLR	Total Usage of Hired Labor, Rabi, All NWFP
		NWFP Regional Input Balances
800	INPFEN	Regional Input Balance for Nitrogen Fertilizer
801	INPFEP	Regional Input Balance for Phosphatic Fertilizer
802	INPFEK	Regional Input Balance for Potash Fertilizer
803	INPHL	Regional Input Balance for Hired Labor
804	INPTTR	Regional Input Balance for Tractor Services
		NWFP Regional Domestic Marketing
805	MNPRIB	Domestic Marketing from NWFP of Basmati Rice
806	MNPRIO	Domestic Marketing from NWFP of Other Rice
807	MNPCOG	Domestic Marketing from NWFP of Coarse Grains
808	MNPCOT	Domestic Marketing from NWFP of Sugar
809	MNPSUG	Domestic Marketing from NWFP of Sugar
810	MNPTOL	Domestic Marketing from NWFP of Trad. Oilseeds
811	MNPNOK	Domestic Marketing from NWFP of Non-trad. Oilseeds
812	MNPPUL	Domestic Marketing from NWFP of All Pulses
813	MNPVEG	Domestic Marketing from NWFP of All Vegetables
814	MNPWHE	Domestic Marketing from NWFP of Wheat
815	MNPNOR	Domestic Marketing from NWFP of Non-Trad. Oilseeds
816	MNPFRU	Domestic Marketing from NWFP of Fruit
817	MNPNMC	Domestic Marketing from NWFP of Beef
818	MNPMCA	Domestic Marketing from NWFP of Milk
819	MNPBUT	Domestic Marketing from NWFP of Butter
820	MNPAGE	Domestic Marketing from NWFP of Animal Ghee
821	MNPGOS	Domestic Marketing from NWFP of Goats and Sheep
822	MNPPOU	Domestic Marketing from NWFP of Poultry
823	MNPEGG	Domestic Marketing from NWFP of Eggs
		Oilseed Cake Feeding To Livestock
824	DF1CAK	Total Livestock Usage of Oilseed Cake, Zone 1
825	DF2CAK	Total Livestock Usage of Oilseed Cake, Zone 2
826	DF3CAK	Total Livestock Usage of Oilseed Cake, Zone 3
827	DF4CAK	Total Livestock Usage of Oilseed Cake, Zone 4
828	DF5CAK	Total Livestock Usage of Oilseed Cake, Zone 5
829	DF6CAK	Total Livestock Usage of Oilseed Cake, Zone 6
830	DF7CAK	Total Livestock Usage of Oilseed Cake, Zone 7
831	MNACTS	National Marketing of Cottonseed (Out of Sequence in Model at Present)

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Row	Name	Description
		NWFP Regional
		Export Marketing
832	MXNVEG	Export Marketing from NWFP of All Vegetables
833	MXNFRU	Export Marketing from NWFP of Fruit
		DOMESTIC DEMAND FUNCTIONS
		Basmati Rice
834	DRIB1	Demand Function for Basmati Rice, Point 1
835	DRIB2	Demand Function for Basmati Rice, Point 2
836	DRIB3	Demand Function for Basmati Rice, Point 3
837	DRIB4	Demand Function for Basmati Rice, Point 4
838	DRIB5	Demand Function for Basmati Rice, Point 5
839	DRIB6	Demand Function for Basmati Rice, Point 6
840	DRIB7	Demand Function for Basmati Rice, Point 7
841	DRIB8	Demand Function for Basmati Rice, Point 8
842	DRIB9	Demand Function for Basmati Rice, Point 9
843	DRIB10	Demand Function for Basmati Rice, Point 10
844	DRIB11	Demand Function for Basmati Rice, Point 11
		Other Rice
845	DRIO1	Demand Function for Other Rice, Point 1
846	DRIO2	Demand Function for Other Rice, Point 2
847	DRIO3	Demand Function for Other Rice, Point 3
848	DRIO4	Demand Function for Other Rice, Point 4
849	DRIO5	Demand Function for Other Rice, Point 5
850	DRIO6	Demand Function for Other Rice, Point 6
851	DRIO7	Demand Function for Other Rice, Point 7
852	DRIO8	Demand Function for Other Rice, Point 8
853	DRIO9	Demand Function for Other Rice, Point 9
854	DRIO10	Demand Function for Other Rice, Point 10
855	DRIO11	Demand Function for Other Rice, Point 11
		Coarse Grains
856	DCOG1	Demand Function for Coarse Grain, Point 1
857	DCOG2	Demand Function for Coarse Grain, Point 2
858	DCOG3	Demand Function for Coarse Grain, Point 3
859	DCOG4	Demand Function for Coarse Grain, Point 4
860	DCOG5	Demand Function for Coarse Grain, Point 5
861	DCOG6	Demand Function for Coarse Grain, Point 6
862	DCOG7	Demand Function for Coarse Grain, Point 7
863	DCOG8	Demand Function for Coarse Grain, Point 8
864	DCOG9	Demand Function for Coarse Grain, Point 9
865	DCOG10	Demand Function for Coarse Grain, Point 10
866	DCOG11	Demand Function for Coarse Grain, Point 11
		Cotton Fiber
867	DCTF1	Demand Function for Cotton Fiber, Point 1
868	DCTF2	Demand Function for Cotton Fiber, Point 2
869	DCTF3	Demand Function for Cotton Fiber, Point 3
870	DCTF4	Demand Function for Cotton Fiber, Point 4
871	DCTF5	Demand Function for Cotton Fiber, Point 5
872	DCTF6	Demand Function for Cotton Fiber, Point 6
873	DCTF7	Demand Function for Cotton Fiber, Point 7
874	DCTF8	Demand Function for Cotton Fiber, Point 8

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Row	Name	Description
875	DCTF9	Demand Function for Cotton Fiber, Point 9
876	DCTF10	Demand Function for Cotton Fiber, Point 10
877	DCTF11	Demand Function for Cotton Fiber, Point 11
		Sugar
878	DSUG1	Demand Function for Sugar, Point 1
879	DSUG2	Demand Function for Sugar, Point 2
880	DSUG3	Demand Function for Sugar, Point 3
881	DSUG4	Demand Function for Sugar, Point 4
882	DSUG5	Demand Function for Sugar, Point 5
883	DSUG6	Demand Function for Sugar, Point 6
884	DSUG7	Demand Function for Sugar, Point 7
885	DSUG8	Demand Function for Sugar, Point 8
886	DSUG9	Demand Function for Sugar, Point 9
887	DSUG10	Demand Function for Sugar, Point 10
888	DSUG11	Demand Function for Sugar, Point 11
		Pulses
889	DPUL1	Demand Function for Pulses, Point 1
890	DPUL2	Demand Function for Pulses, Point 2
891	DPUL3	Demand Function for Pulses, Point 3
892	DPUL4	Demand Function for Pulses, Point 4
893	DPUL5	Demand Function for Pulses, Point 5
894	DPUL6	Demand Function for Pulses, Point 6
895	DPUL7	Demand Function for Pulses, Point 7
896	DPUL8	Demand Function for Pulses, Point 8
897	DPUL9	Demand Function for Pulses, Point 9
898	DPUL10	Demand Function for Pulses, Point 10
899	DPUL11	Demand Function for Pulses, Point 11
		Vegetables
900	DVEG1	Demand Function for Vegetables, Point 1
901	DVEG2	Demand Function for Vegetables, Point 2
902	DVEG3	Demand Function for Vegetables, Point 3
903	DVEG4	Demand Function for Vegetables, Point 4
904	DVEG5	Demand Function for Vegetables, Point 5
905	DVEG6	Demand Function for Vegetables, Point 6
906	DVEG7	Demand Function for Vegetables, Point 7
907	DVEG8	Demand Function for Vegetables, Point 8
908	DVEG9	Demand Function for Vegetables, Point 9
909	DVEG10	Demand Function for Vegetables, Point 10
910	DVEG11	Demand Function for Vegetables, Point 11
		Fruit
911	DFRU1	Demand Function for Fruit, Point 1
912	DFRU2	Demand Function for Fruit, Point 2
913	DFRU3	Demand Function for Fruit, Point 3
914	DFRU4	Demand Function for Fruit, Point 4
915	DFRU5	Demand Function for Fruit, Point 5
916	DFRU6	Demand Function for Fruit, Point 6
917	DFRU7	Demand Function for Fruit, Point 7
918	DFRU8	Demand Function for Fruit, Point 8
919	DFRU9	Demand Function for Fruit, Point 9
920	DFRU10	Demand Function for Fruit, Point 10
921	DFRU11	Demand Function for Fruit, Point 11

Row	Name	Description
		Wheat
922	DWHE1	Demand Function for Wheat, Point 1
923	DWHE2	Demand Function for Wheat, Point 2
924	DWHE3	Demand Function for Wheat, Point 3
925	DWHE4	Demand Function for Wheat, Point 4
926	DWHE5	Demand Function for Wheat, Point 5
927	DWHE6	Demand Function for Wheat, Point 6
928	DWHE7	Demand Function for Wheat, Point 7
929	DWHE8	Demand Function for Wheat, Point 8
930	DWHE9	Demand Function for Wheat, Point 9
931	DWHE10	Demand Function for Wheat, Point 10
932	DWHE11	Demand Function for Wheat, Point 11
		Vegetable Ghee
933	DVGE1	Demand Function for Vegetable Ghee, Point 1
934	DVGE2	Demand Function for Vegetable Ghee, Point 2
935	DVGE3	Demand Function for Vegetable Ghee, Point 3
936	DVGE4	Demand Function for Vegetable Ghee, Point 4
937	DVGE5	Demand Function for Vegetable Ghee, Point 5
938	DVGE6	Demand Function for Vegetable Ghee, Point 6
939	DVGE7	Demand Function for Vegetable Ghee, Point 7
940	DVGE8	Demand Function for Vegetable Ghee, Point 8
941	DVGE9	Demand Function for Vegetable Ghee, Point 9
942	DVGE10	Demand Function for Vegetable Ghee, Point 10
943	DVGE11	Demand Function for Vegetable Ghee, Point 11
		Liquid Oil
944	DLOI1	Demand Function for Liquid Oil, Point 1
945	DLOI2	Demand Function for Liquid Oil, Point 2
946	DLOI3	Demand Function for Liquid Oil, Point 3
947	DLOI4	Demand Function for Liquid Oil, Point 4
948	DLOI5	Demand Function for Liquid Oil, Point 5
949	DLOI6	Demand Function for Liquid Oil, Point 6
950	DLOI7	Demand Function for Liquid Oil, Point 7
951	DLOI8	Demand Function for Liquid Oil, Point 8
952	DLOI9	Demand Function for Liquid Oil, Point 9
953	DLOI10	Demand Function for Liquid Oil, Point 10
954	DLOI11	Demand Function for Liquid Oil, Point 11
		Beef
955	DBEE1	Demand Function for Beef, Point 1
956	DBEE2	Demand Function for Beef, Point 2
957	DBEE3	Demand Function for Beef, Point 3
958	DBEE4	Demand Function for Beef, Point 4
959	DBEE5	Demand Function for Beef, Point 5
960	DBEE6	Demand Function for Beef, Point 6
961	DBEE7	Demand Function for Beef, Point 7
962	DBEE8	Demand Function for Beef, Point 8
963	DBEE9	Demand Function for Beef, Point 9
964	DBEE10	Demand Function for Beef, Point 10
965	DBEE11	Demand Function for Beef, Point 11
		Milk
966	DMIL1	Demand Function for Milk, Point 1
967	DMIL2	Demand Function for Milk, Point 2
968	DMIL3	Demand Function for Milk, Point 3

Row	Name	Description
969	DMIL4	Demand Function for Milk, Point 4
970	DMIL5	Demand Function for Milk, Point 5
971	DMIL6	Demand Function for Milk, Point 6
972	DMIL7	Demand Function for Milk, Point 7
973	DMIL8	Demand Function for Milk, Point 8
974	DMIL9	Demand Function for Milk, Point 9
975	DMIL10	Demand Function for Milk, Point 10
976	DMIL11	Demand Function for Milk, Point 11
		Butter
977	DBUT1	Demand Function for Butter, Point 1
978	DBUT2	Demand Function for Butter, Point 2
979	DBUT3	Demand Function for Butter, Point 3
980	DBUT4	Demand Function for Butter, Point 4
981	DBUT5	Demand Function for Butter, Point 5
982	DBUT6	Demand Function for Butter, Point 6
983	DBUT7	Demand Function for Butter, Point 7
984	DBUT8	Demand Function for Butter, Point 8
985	DBUT9	Demand Function for Butter, Point 9
986	DBUT10	Demand Function for Butter, Point 10
987	DBUT11	Demand Function for Butter, Point 11
		Animal Ghee
988	DAGE1	Demand Function for Animal Ghee, Point 1
989	DAGE2	Demand Function for Animal Ghee, Point 2
990	DAGE3	Demand Function for Animal Ghee, Point 3
991	DAGE4	Demand Function for Animal Ghee, Point 4
992	DAGE5	Demand Function for Animal Ghee, Point 5
993	DAGE6	Demand Function for Animal Ghee, Point 6
994	DAGE7	Demand Function for Animal Ghee, Point 7
995	DAGE8	Demand Function for Animal Ghee, Point 8
996	DAGE9	Demand Function for Animal Ghee, Point 9
997	DAGE10	Demand Function for Animal Ghee, Point 10
998	DAGE11	Demand Function for Animal Ghee, Point 11
		Mutton
999	DMUT1	Demand Function for Mutton, Point 1
1000	DMUT2	Demand Function for Mutton, Point 2
1001	DMUT3	Demand Function for Mutton, Point 3
1002	DMUT4	Demand Function for Mutton, Point 4
1003	DMUT5	Demand Function for Mutton, Point 5
1004	DMUT6	Demand Function for Mutton, Point 6
1005	DMUT7	Demand Function for Mutton, Point 7
1006	DMUT8	Demand Function for Mutton, Point 8
1007	DMUT9	Demand Function for Mutton, Point 9
1008	DMUT10	Demand Function for Mutton, Point 10
1009	DMUT11	Demand Function for Mutton, Point 11
		Poultry
1010	DPOU1	Demand Function for Poultry, Point 1
1011	DPOU2	Demand Function for Poultry, Point 2
1012	DPOU3	Demand Function for Poultry, Point 3
1013	DPOU4	Demand Function for Poultry, Point 4
1014	DPOU5	Demand Function for Poultry, Point 5
1015	DPOU6	Demand Function for Poultry, Point 6
1016	DPOU7	Demand Function for Poultry, Point 7
1017	DPOU8	Demand Function for Poultry, Point 8

Row	Name	Description
1018	DPOU9	Demand Function for Poultry, Point 9
1019	DPOU10	Demand Function for Poultry, Point 10
1020	DPOU11	Demand Function for Poultry, Point 11
		Eggs
1021	DEGG1	Demand Function for Eggs, Point 1
1022	DEGG2	Demand Function for Eggs, Point 2
1023	DEGG3	Demand Function for Eggs, Point 3
1024	DEGG4	Demand Function for Eggs, Point 4
1025	DEGG5	Demand Function for Eggs, Point 5
1026	DEGG6	Demand Function for Eggs, Point 6
1027	DEGG7	Demand Function for Eggs, Point 7
1028	DEGG8	Demand Function for Eggs, Point 8
1029	DEGG9	Demand Function for Eggs, Point 9
1030	DEGG10	Demand Function for Eggs, Point 10
1031	DEGG11	Demand Function for Eggs, Point 11
		Domestic Processing of Vegetable Ghee
1032	VGDTOL	Domestic Processing of Trad. Oilseeds to Veg. Ghee
1033	VGDNOL	Domestic Processing of Non-Trad. Oilseeds to Veg. Ghee
1034	VGDCTS	Domestic Processing of Cottonseed to Veg. Ghee
		Domestic Processing of Liquid Oil
1035	LOITOL	Domestic Processing of Trad. Oilseeds to Liquid Oil
1036	LOINOL	Domestic Processing of Non-Trad. Oilseeds to Liquid Oil
1037	LOICTS	Domestic Processing of Cottonseed to Liquid Oil
		Import-to-Retail Handling/Marketing
1038	MIRSUG	Domestic Marketing of Imported Sugar
1039	MIRPUL	Domestic Marketing of Imported Pulses
1040	MIRWHE	Domestic Marketing of Imported Wheat
1041	MIRMIL	Domestic Marketing of Imported Milk
		Processing of Imported Vegetable Ghee
1042	VGESOY	Processing of Imported Soybean Oil to Veg. Ghee
1043	VGEPAL	Processing of Imported Palm Oil to Veg. Ghee
		Processing of Imported Liquid Oil
1044	LOISOY	Processing of Imported Soybean to Liquid Oil
1045	LOIPAL	Processing of Imported Palm Oil to Liquid Oil
		Import-to-Processing of Edible Oils
1046	MIPSOY	Import-to-Processing of Soybean
1047	MIPPAL	Import-to-Processing of Palm Oil

Row	Name	Description
		Imports
1048	IMSUG	Imports of Sugar
1049	IMPUL	Imports of Pulses
1050	IMWHE	Imports of Weat
1051	IMSOYO	Imports Soybean Oil
1052	IMPALO	Imports of Palm Oil
1053	IMMIL	Imports of Milk
		Basmati Export Function
1054	DRIE1	Exports of Basmati Rice, Point 1
1055	DRIE2	Exports of Basmati Rice, Point 2
1056	DRIE3	Exports of Basmati Rice, Point 3
1057	DRIE4	Exports of Basmati Rice, Point 4
1058	DRIE5	Exports of Basmati Rice, Point 5
1059	DRIE6	Exports of Basmati Rice, Point 6
1060	DRIE7	Exports of Basmati Rice, Point 7
1061	DRIE8	Exports of Basmati Rice, Point 8
1062	DRIE9	Exports of Basmati Rice, Point 9
1063	DRIE10	Exports of Basmati Rice, Point 10
1064	DRIE11	Exports of Basmati Rice, Point 11
		Exports
1065	EXRIO	Exports of Other Rice
1066	EXCTF	Exports of Cottonseed Fiber
1067	EXVEG	Exports of Vegetables
1068	EXFRU	Exports of Fruit
1069	AFARMI	**Farm Income Accounting Column**

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ANNEX VII

A LIST OF PASM EQUATIONS

This annex presents the equations in the model using the exact variable names and coefficients found in the Base Solution. First the objective function is shown, which is then followed by 558 constraint equations. For each equation, the title is given first before the actual listing. The order of the equation is identical to the presentation of the row definitions in Annex VI. The same headings in Annex VI are used here to separate the equations into groups of similar constraints.

PAKISTAN AGRICULTURAL SECTOR MODEL

List of Equations

```
MAXIMIZE:
        CPS) - 0.0405 PS1RIB - 0.03661 PS1RIO - 0.02446 PS1COG - 0.06628 PS1CO3
        - 0.06628 PS1CO4 - 0.13502 PS1SUG - 0.0435  PS1TOK - 0.01587 PS1NOK
        - 0.01528 PS1PUK - 0.03106 PS1VEK - 0.03882 PS1FDK - 0.0475  PS1WHE
        - 0.0475  PS1WHL - 0.02517 PS1BAR - 0.03643 PS1PUR - 1.39147 PS1HVA
        - 0.01334 PS1TOR - 0.01502 PS1NOR - 0.02781 PS1FDR - 0.04227 PS1FRU
        - 0.04076 PM1RIB - 0.04321 PM1RIO - 0.02612 PM1COG - 0.06869 PM1CO3
        - 0.06869 PM1CO4 - 0.15576 PM1SUG - 0.04849 PM1TOK - 0.02086 PM1NOK
        - 0.01584 PM1PUK - 0.03369 PM1VEK - 0.04327 PM1FDK - 0.0486  PM1WHE
        - 0.0486  PM1WHL - 0.02588 PM1BAR - 0.03759 PM1PUR - 1.3953  PM1HVA
        - 0.01486 PM1TOR - 0.01654 PM1NOR - 0.03227 PM1FDR - 0.05358 PM1FRU
        - 0.04944 PL1RIB - 0.04331 PL1RIO - 0.02796 PL1COG - 0.0705  PL1CO3
        - 0.0705  PL1CO4 - 0.16289 PL1SUG - 0.05588 PL1TOK - 0.02825 PL1NOK
        - 0.01683 PL1PUK - 0.0364 PL1VEK  - 0.05123 PL1FDK - 0.04897 PL1WHE
        - 0.04897 PL1WHL - 0.02674 PL1BAR - 0.0387  PL1PUR - 1.38365 PL1HVA
        - 0.01628 PL1TOR - 0.01796 PL1NOR - 0.04023 PL1FDR - 0.07893 PL1FRU
        - 0.00005 HS1WHE - 0.00008 HS1RIC - 0.00005 HM1WHE - 0.00008 HM1RIC
        - 0.00005 HL1WHE - 0.00008 HL1RIC - 0.03626 IB1TUK - 0.03626 IB1TUR
        - 0.02583 PS2RIB - 0.03403 PS2RIO - 0.02325 PS2COG - 0.06307 PS2CO3
        - 0.06307 PS2CO4 - 0.15868 PS2SUG - 0.03463 PS2TOK - 0.01567 PS2NOK
        - 0.01458 PS2PUK - 0.03252 PS2VEK - 0.03455 PS2FDK - 0.05067 PS2WHE
        - 0.05067 PS2WHL - 0.02519 PS2BAR - 0.04561 PS2PUR - 1.23146 PS2HVA
        - 0.01339 PS2TOR - 0.01507 PS2NOR - 0.02785 PS2FDR - 0.04227 PS2FRU
        - 0.02942 PM2RIB - 0.03731 PM2RIO - 0.0303  PM2COG - 0.07579 PM2CO3
        - 0.07579 PM2CO4 - 0.18057 PM2SUG - 0.03961 PM2TOK - 0.02065 PM2NOK
        - 0.01514 PM2PUK - 0.03515 PM2VEK - 0.039   PM2FDK - 0.05742 PM2WHE
        - 0.05742 PM2WHL - 0.02588 PM2BAR - 0.04678 PM2PUR - 1.23529 PM2HVA
        - 0.01491 PM2TOR - 0.01659 PM2NOR - 0.0323  PM2FDR - 0.05358 PM2FRU
        - 0.03061 PL2RIB - 0.04035 PL2RIO - 0.0326  PL2COG - 0.08859 PL2CO3
        - 0.08859 PL2CO4 - 0.18741 PL2SUG - 0.047   PL2TOK - 0.02804 PL2NOK
        - 0.01612 PL2PUK - 0.03776 PL2VEK - 0.04696 PL2FDK - 0.05281 PL2WHE
        - 0.05281 PL2WHL - 0.02672 PL2BAR - 0.04789 PL2PUR - 1.22364 PL2HVA
        - 0.01633 PL2TOR - 0.01801 PL2NOR - 0.04027 PL2FDR - 0.07893 PL2FRU
        - 0.00005 HS2WHE - 0.00008 HS2RIC - 0.00005 HM2WHE - 0.00008 HM2RIC
        - 0.00005 HL2WHE - 0.00008 HL2RIC - 0.03837 IB2TUK - 0.03837 IB2TUR
        - 0.02833 PS3RIB - 0.03373 PS3RIO - 0.02756 PS3COG - 0.07668 PS3CO3
        - 0.07668 PS3CO4 - 0.16135 PS3SUG - 0.0348  PS3TOK - 0.01593 PS3NOK
        - 0.01564 PS3PUK - 0.03094 PS3VEK - 0.03422 PS3FDK - 0.05566 PS3WHE
        - 0.05566 PS3WHB - 0.02518 PS3BAR - 0.04204 PS3PUR - 1.27778 PS3HVA
        - 0.01321 PS3TOR - 0.01503 PS3NOR - 0.02783 PS3FDR - 0.04227 PS3FRU
        - 0.03345 PM3RIB - 0.03303 PM3RIO - 0.03748 PM3COG - 0.0683  PM3CO3
        - 0.0683  PM3CO4 - 0.15341 PM3SUG - 0.03978 PM3TOK - 0.02092 PM3NOK
        - 0.0162  PM3PUK - 0.03358 PM3VEK - 0.03867 PM3FDK - 0.05316 PM3WHE
        - 0.05316 PM3WHB - 0.0259  PM3BAR - 0.0432  PM3PUR - 1.28026 PM3HVA
        - 0.01474 PM3TOR - 0.01655 PM3NOR - 0.03228 PM3FDR - 0.05358 PM3FRU
        - 0.03116 PL3RIB - 0.04005 PL3RIO - 0.02135 PL3COG - 0.07217 PL3CO3
        - 0.07217 PL3CO4 - 0.15323 PL3SUG - 0.04717 PL3TOK - 0.02831 PL3NOK
        - 0.01719 PL3PUK - 0.03574 PL3VEK - 0.04663 PL3FDK - 0.05571 PL3WHE
        - 0.05571 PL3WHB - 0.02675 PL3BAR - 0.04431 PL3PUR - 1.26405 PL3HVA
        - 0.01616 PL3TOR - 0.01797 PL3NOR - 0.04025 PL3FDR - 0.07893 PL3FRU
        - 0.00005 HS3WHE - 0.00008 HS3RIC - 0.00005 HM3WHE - 0.00008 HM3RIC
        - 0.00005 HL3WHE - 0.00008 HL3RIC - 0.04009 IB3TUK - 0.04009 IB3TUR
        - 0.00057 IPUFEN - 0.00048 IPUFEP - 0.00025 IPUFEK - 0.00031 IPUHL
        - 0.00673 IPUTTR - 0.00013 MPURIB - 0.00006 MPURIO - 0.00002 MPUCOG
        - 0.01137 MPUCOT - 0.00004 MPUSUG - 0.00023 MPUPUL - 0.00024 MPUVEG
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-	0.00005	MPUWHE	- 0.00037	MPUFRU	- 0.00019	MPUNMC	- 0.0004	MPUMCA
-	0.00214	MPUBUT	- 0.00005	MPUAGE	- 0.00069	MPUGOS	- 0.00056	MPUPOU
-	0.00001	MPUEGG	- 0.00052	MXPRIB	- 0.0001	MXPRIO	- 0.00187	MXPCTF
-	0.00025	MXPVEG	- 0.00027	MXPFRU	- 0.03443	PS4RIO	- 0.01899	PS4COG
-	0.11252	PS4CO3	- 0.11252	PS4CO4	- 0.1395	PS4SUG	- 0.03303	PS4TOK
-	0.01637	PS4NOK	- 0.01082	PS4PUK	- 0.07395	PS4VEK	- 0.02237	PS4FDK
-	0.05272	PS4WHE	- 0.05272	PS4WHL	- 0.02474	PS4BAR	- 0.03828	PS4PUR
-	1.28329	PS4HVA	- 0.02324	PS4TOR	- 0.02685	PS4NOR	- 0.02679	PS4FDR
-	0.03903	PS4FRU	- 0.0426	PM4RIO	- 0.02065	PM4COG	- 0.11494	PM4CO3
-	0.11494	PM4CO4	- 0.15903	PM4SUG	- 0.03869	PM4TOK	- 0.02203	PM4NOK
-	0.01205	PM4PUK	- 0.07658	PM4VEK	- 0.02682	PM4FDK	- 0.05358	PM4WHE
-	0.05358	PM4WHL	- 0.02606	PM4BAR	- 0.03944	PM4PUR	- 1.28914	PM4HVA
-	0.02476	PM4TOR	- 0.02837	PM4NOR	- 0.03124	PM4FDR	- 0.04604	PM4FRU
-	0.04043	PL4RIO	- 0.02249	PL4COG	- 0.11675	PL4CO3	- 0.11675	PL4CO4
-	0.16626	PL4SUG	- 0.04653	PL4TOK	- 0.02987	PL4NOK	- 0.01349	PL4PUK
-	0.07932	PL4VEK	- 0.03478	PL4FDK	- 0.05534	PL4WHE	- 0.05534	PL4WHL
-	0.02732	PL4BAR	- 0.04055	PL4PUR	- 1.27166	PL4HVA	- 0.02618	PL4TOR
-	0.02979	PL4NOR	- 0.03921	PL4FDR	- 0.06294	PL4FRU	- 0.00005	HS4WHE
-	0.00008	HS4RIC	- 0.00005	HM4WHE	- 0.00008	HM4RIC	- 0.00005	HL4WHE
-	0.00008	HL4RIC	- 0.03766	IB4TUK	- 0.03766	IB4TUR	- 0.03098	PS5RIO
-	0.00185	PS5COG	- 0.12464	PS5CO3	- 0.12464	PS5CO4	- 0.16394	PS5SUG
-	0.04026	PS5TOK	- 0.01761	PS5NOK	- 0.01052	PS5PUK	- 0.07708	PS5VEK
-	0.02223	PS5FDK	- 0.05777	PS5WHE	- 0.05777	PS5WHL	- 0.01978	PS5BAR
-	0.03434	PS5PUR	- 0.07056	PS5HVA	- 0.0158	PS5TOR	- 0.02005	PS5NOR
-	0.01893	PS5FDR	- 0.03903	PS5FRU	- 0.03116	PM5RIO	- 0.02366	PM5COG
-	0.11738	PM5CO3	- 0.11738	PM5CO4	- 0.15505	PM5SUG	- 0.04592	PM5TOK
-	0.02327	PM5NOK	- 0.01175	PM5PUK	- 0.07972	PM5VEK	- 0.02669	PM5FDK
-	0.05578	PM5WHE	- 0.05578	PM5WHL	- 0.0206	PM5BAR	- 0.0355	PM5PUR
-	0.07371	PM5HVA	- 0.01732	PM5TOR	- 0.02158	PM5NOR	- 0.02338	PM5FDR
-	0.04604	PM5FRU	- 0.0373	PL5RIO	- 0.00426	PL5COG	- 0.12312	PL5CO3
-	0.12312	PL5CO4	- 0.15418	PL5SUG	- 0.05376	PL5TOK	- 0.0311	PL5NOK
-	0.01319	PL5PUK	- 0.08179	PL5VEK	- 0.03465	PL5FDK	- 0.05838	PL5WHE
-	0.05838	PL5WHL	- 0.02152	PL5BAR	- 0.03662	PL5PUR	- 0.04819	PL5HVA
-	0.01874	PL5TOR	- 0.023	PL5NOR	- 0.03135	PL5FDR	- 0.06294	PL5FRU
-	0.00005	HS5WHE	- 0.00008	HS5RIC	- 0.00005	HM5WHE	- 0.00008	HM5RIC
-	0.00005	HL5WHE	- 0.00008	HL5RIC	- 0.03766	IB5TUK	- 0.03766	IB5TUR
-	0.00057	ISIFEN	- 0.00048	ISIFEP	- 0.00025	ISIFEK	- 0.00027	ISIHL
-	0.00673	ISITTR	- 0.00006	MSIRIO	- 0.00002	MSICOG	- 0.01137	MSICTF
-	0.00004	MSISUG	- 0.00023	MSIPUL	- 0.00024	MSIVEG	- 0.00005	MSIWHE
-	0.00037	MSIFRU	- 0.00019	MSINMC	- 0.0004	MSIMCA	- 0.00214	MSIBUT
-	0.00005	MSIAGE	- 0.00069	MSIGOS	- 0.00056	MSIPOU	- 0.00001	MSIEGG
-	0.0001	MXSRIO	- 0.00187	MXSCTF	- 0.00025	MXSVEG	- 0.00027	MXSFRU
-	0.02217	PS6RIB	- 0.02643	PS6RIO	- 0.02122	PS6COG	- 0.25123	PS6SUG
-	0.03902	PS6TOK	- 0.01755	PS6PUK	- 0.10241	PS6VEK	- 0.02035	PS6FDK
-	0.03621	PS6WHE	- 0.03621	PS6WHL	- 0.03314	PS6BAR	- 0.02686	PS6PUR
-	0.79669	PS6HVA	- 0.01406	PS6TOR	- 0.02823	PS6FDR	- 0.07493	PS6FRU
-	0.02817	PM6RIB	- 0.02768	PM6RIO	- 0.02087	PM6COG	- 0.26603	PM6SUG
-	0.04401	PM6TOK	- 0.01811	PM6PUK	- 0.10505	PM6VEK	- 0.02481	PM6FDK
-	0.03593	PM6WHE	- 0.03593	PM6WHL	- 0.03293	PM6BAR	- 0.02673	PM6PUR
-	0.80117	PM6HVA	- 0.01558	PM6TOR	- 0.03268	PM6FDR	- 0.10576	PM6FRU
-	0.02771	PL6RIB	- 0.03061	PL6RIO	- 0.02129	PL6COG	- 0.27184	PL6SUG
-	0.05139	PL6TOK	- 0.01909	PL6PUK	- 0.1078	PL6VEK	- 0.03277	PL6FDK
-	0.03777	PL6WHE	- 0.03777	PL6WHL	- 0.03431	PL6BAR	- 0.02705	PL6PUR
-	0.80489	PL6HVA	- 0.017	PL6TOR	- 0.04064	PL6FDR	- 0.12799	PL6FRU
-	0.00005	HS6WHE	- 0.00008	HS6RIC	- 0.00005	HM6WHE	- 0.00008	HM6RIC
-	0.00005	HL6WHE	- 0.00008	HL6RIC	- 0.02974	IB6TUK	- 0.02974	IB6TUR
-	0.00059	IBAFEN	- 0.00049	IBAFEP	- 0.00026	IBAFEK	- 0.00031	IBAHL
-	0.00673	IBATTR	- 0.00013	MBARIB	- 0.00006	MBARIO	- 0.00002	MBACOG
-	0.00004	MBASUG	- 0.00023	MBAPUL	- 0.00024	MBAVEG	- 0.00005	MBAWHE
-	0.00037	MBAFRU	- 0.00019	MBANMC	- 0.0004	MBAMCA	- 0.00214	MBABUT
-	0.00005	MBAAGE	- 0.00069	MBAGOS	- 0.00056	MBAPOU	- 0.00001	MBAEGG
-	0.00025	MXBVEG	- 0.00027	MXBFRU	- 0.03962	PS7RIB	- 0.03271	PS7RIO

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- 0.02103 PS7COG - 0.03919 PS7COT - 0.13616 PS7SUG - 0.0289  PS7TOK
- 0.01244 PS7NOK - 0.01477 PS7PUK - 0.02189 PS7VEK - 0.0141  PS7FDK
- 0.0355  PS7WHE - 0.0355  PS7WHL - 0.0221  PS7BAR - 0.02828 PS7PUR
- 1.25445 PS7HVA - 0.01169 PS7TOR - 0.01404 PS7NOR - 0.01579 PS7FDR
- 0.07493 PS7FRU - 0.01826 PS8RIB - 0.01285 PS8RIO - 0.01854 PS8COG
- 0.04344 PS8COT - 0.12665 PS8SUG - 0.03669 PS8TOK - 0.01427 PS8NOK
- 0.01462 PS8PUK - 0.02545 PS8VEK - 0.02387 PS8FDK - 0.03042 PS8WHE
- 0.03042 PS8WHL - 0.02527 PS8BAR - 0.03048 PS8PUR - 1.51958 PS8HVA
- 0.01067 PS8TOR - 0.01267 PS8NOR - 0.01933 PS8FDR - 0.07493 PS8FRU
- 0.03867 PM7RIB - 0.03726 PM7RIO - 0.02206 PM7COG - 0.04084 PM7COT
- 0.13864 PM7SUG - 0.03238 PM7TOK - 0.01591 PM7NOK - 0.01515 PM7PUK
- 0.0237  PM7VEK - 0.01466 PM7FDK - 0.03652 PM7WHE - 0.03652 PM7WHL
- 0.02263 PM7BAR - 0.02907 PM7PUR - 1.25739 PM7HVA - 0.01273 PM7TOR
- 0.01508 PM7NOR - 0.0163  PM7FDR - 0.10576 PM7FRU - 0.0217  PM8RIB
- 0.01232 PM8RIO - 0.01844 PM8COG - 0.0515  PM8COT - 0.13683 PM8SUG
- 0.04099 PM8TOK - 0.01857 PM8NOK - 0.0151  PM8PUK - 0.02771 PM8VEK
- 0.02655 PM8FDK - 0.03115 PM8WHE - 0.03115 PM8WHL - 0.02582 PM8BAR
- 0.03048 PM8PUR - 1.523   PM8HVA - 0.01198 PM8TOR - 0.01397 PM8NOR
- 0.02199 PM8FDR - 0.10576 PM8FRU - 0.04489 PL7RIB - 0.03789 PL7RIO
- 0.02317 PL7COG - 0.04207 PL7COT - 0.14118 PL7SUG - 0.03753 PL7TOK
- 0.02106 PL7NOK - 0.01583 PL7PUK - 0.02552 PL7VEK - 0.01529 PL7FDK
- 0.04115 PL7WHE - 0.04115 PL7WHL - 0.02324 PL7BAR - 0.02982 PL7PUR
- 1.25965 PL7HVA - 0.0137  PL7TOR - 0.01605 PL7NOR - 0.01675 PL7FDR
- 0.12799 PL7FRU - 0.01942 PL8RIB - 0.01827 PL8RIO - 0.01869 PL8COG
- 0.05855 PL8COT - 0.14144 PL8SUG - 0.04736 PL8TOK - 0.02494 PL8NOK
- 0.01595 PL8PUK - 0.03005 PL8VEK - 0.03119 PL8FDK - 0.03207 PL8WHE
- 0.03207 PL8WHL - 0.02651 PL8BAR - 0.03048 PL8PUR - 1.51767 PL8HVA
- 0.01319 PL8TOR - 0.01519 PL8NOR - 0.02655 PL8FDR - 0.12799 PL8FRU
- 0.00005 HS7WHE - 0.00008 HS7RIC - 0.00005 HM7WHE - 0.00008 HM7RIC
- 0.00005 HL7WHE - 0.00008 HL7RIC - 0.02582 IB7TUK - 0.02582 IB7TUR
- 0.00059 INPFEN - 0.00049 INPFEP - 0.00026 INPFEK - 0.00025 INPHL
- 0.00673 INPTTR - 0.00013 MNPRIB - 0.00006 MNPRIO - 0.00002 MNPCOG
- 0.01137 MNPCOT - 0.00004 MNPSUG - 0.00023 MNPPUL - 0.00024 MNPVEG
- 0.00005 MNPWHE - 0.00037 MNPFRU - 0.00019 MNPNMC - 0.0004  MNPMCA
- 0.00214 MNPBUT - 0.00005 MNPAGE - 0.00069 MNPGOS - 0.00056 MNPPOU
- 0.00001 MNPEGG - 0.00025 MXNVEG - 0.00027 MXNFRU +  951.724 DRIB1
+ 1018.345 DRIB2 + 1079.774 DRIB3 + 1136.012 DRIB4 + 1187.059 DRIB5
+ 1232.915 DRIB6 + 1273.58  DRIB7 + 1309.053 DRIB8 + 1339.335 DRIB9
+ 1364.426 DRIB10+ 1384.326 DRIB11+ 1374.475 DRIO1 + 1428.188 DRIO2
+ 1477.715 DRIO3 + 1523.058 DRIO4 + 1564.214 DRIO5 + 1601.186 DRIO6
+ 1633.971 DRIO7 + 1662.572 DRIO8 + 1686.987 DRIO9 + 1707.216 DRIO10
+ 1723.261 DRIO11+  548.14  DCOG1 +  586.51  DCOG2 +  621.89  DCOG3
+  654.28  DCOG4 +  683.68  DCOG5 +  710.09  DCOG6 +  733.511 DCOG7
+  753.941 DCOG8 +  771.382 DCOG9 +  785.833 DCOG10+  797.294 DCOG11
+ 1203.926 DCTF2 + 2314.039 DCTF3 + 3337.339 DCTF4 + 4252.828 DCTF5
+ 5081.504 DCTF6 + 5816.367 DCTF7 + 6457.419 DCTF8 + 7004.658 DCTF9
+ 7458.084 DCTF10+ 7817.698 DCTF11+ 6137.875 DSUG1 + 6306.666 DSUG2
+ 6462.305 DSUG3 + 6604.792 DSUG4 + 6734.126 DSUG5 + 6850.307 DSUG6
+ 6953.335 DSUG7 + 7043.211 DSUG8 + 7119.935 DSUG9 + 7183.506 DSUG10
+ 7233.924 DSUG11+  817.597 DPUL1 +  860.954 DPUL2 +  900.932 DPUL3
+  937.532 DPUL4 +  970.753 DPUL5 + 1000.596 DPUL6 + 1027.061 DPUL7
+ 1050.147 DPUL8 + 1069.855 DPUL9 + 1086.184 DPUL10+ 1099.134 DPUL11
+ 4098.264 DVEG1 + 4210.967 DVEG2 + 4314.887 DVEG3 + 4410.025 DVEG4
+ 4496.381 DVEG5 + 4573.956 DVEG6 + 4642.748 DVEG7 + 4702.758 DVEG8
+ 4753.987 DVEG9 + 4796.433 DVEG10+ 4830.097 DVEG11+ 5732.783 DFRU1
+ 5890.434 DFRU2 + 6035.801 DFRU3 + 6168.884 DFRU4 + 6289.682 DFRU5
+ 6398.195 DFRU6 + 6494.424 DFRU7 + 6578.368 DFRU8 + 6650.028 DFRU9
+ 6709.403 DFRU10+ 6756.494 DFRU11+ 5897.999 DWHE1 + 6128.487 DWHE2
+ 6341.014 DWHE3 + 6535.582 DWHE4 + 6712.189 DWHE5 + 6870.836 DWHE6
+ 7011.523 DWHE7 + 7134.251 DWHE8 + 7239.018 DWHE9 + 7325.825 DWHE10
+ 7394.672 DWHE11+ 2003.702 DVGE1 + 2326.326 DVGE2 + 2623.811 DVGE3
+ 2896.156 DVGE4 + 3143.362 DVGE5 + 3365.428 DVGE6 + 3562.354 DVGE7
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+ 3734.141 DVGE8 + 3880.789 DVGE9 + 4002.297 DVGE10 + 4098.665 DVGE11
+  102.821 DLOI1 +  119.377 DLOI2 +  134.643 DLOI3  +  148.618 DLOI4
+  161.304 DLOI5 +  172.699 DLOI6 +  182.805 DLOI7  +  191.62  DLOI8
+  199.145 DLOI9 +  205.381 DLOI10+  210.326 DLOI11 +  404.756 DBEE1
+  640.081 DBEE2 +  857.068 DBEE3 + 1055.719 DBEE4  + 1236.033 DBEE5
+ 1398.01  DBEE6 + 1541.65  DBEE7 + 1666.952 DBEE8  + 1773.918 DBEE9
+ 1862.547 DBEE10+ 1932.839 DBEE11+ 4655.115 DMIL1  + 6355.595 DMIL2
+ 7923.57  DMIL3 + 9359.04  DMIL4 + 10662.01 DMIL5  + 11832.47 DMIL6
+ 12870.42 DMIL7 + 13775.87 DMIL8 + 14548.82 DMIL9  + 15189.26 DMIL10
+ 15697.2  DMIL11+  318.791 DBUT1 +  370.121 DBUT2  +  417.451 DBUT3
+  460.782 DBUT4 +  500.113 DBUT5 +  535.444 DBUT6  +  566.775 DBUT7
+  594.106 DBUT8 +  617.438 DBUT9 +  636.77  DBUT10 +  652.102 DBUT11
+  595.857 DAGE1 +  691.798 DAGE2 +  780.263 DAGE3  +  861.253 DAGE4
+  934.766 DAGE5 + 1000.804 DAGE6 + 1059.366 DAGE7  + 1110.451 DAGE8
+ 1154.061 DAGE9 + 1190.195 DAGE10+ 1218.852 DAGE11 +  430.119 DMUT1
+  973.899 DMUT2 + 1475.308 DMUT3 + 1934.343 DMUT4  + 2351.006 DMUT5
+ 2725.297 DMUT6 + 3057.215 DMUT7 + 3346.76  DMUT8  + 3593.933 DMUT9
+ 3798.734 DMUT10+ 3961.162 DMUT11+  108.604 DPOU2  +  208.746 DPOU3
+  300.425 DPOU4 +  383.641 DPOU5 +  458.395 DPOU6  +  524.686 DPOU7
+  582.514 DPOU8 +  631.88  DPOU9 +  672.783 DPOU10 +  705.223 DPOU11
+  370.302 DEGG1 +  432.814 DEGG2 +  490.455 DEGG3  +  543.225 DEGG4
+  591.124 DEGG5 +  634.152 DEGG6 +  672.309 DEGG7  +  705.594 DEGG8
+  734.009 DEGG9 +  757.552 DEGG10+  776.225 DEGG11 - .000285  VGDTOL
- .000305  VGDNOL-.000085   VGDCTS- .000359  LOITOL - .000383  LOINOL
- .000107  LOICTS- .000534  MIRSUG- .000568  MIRPUL + .000281  MIRWHE
- .000598  MIRMIL- .000799  VGESOY- .000799  VGEPAL - .000940  LOISOY
- .000940  LOIPAL- .000394  IMSUG - .000543  IMPUL  - .000322  IMWHE
- .000500  IMSOYO- .000500  IMPALO- .000108  IMMIL  +  353.512 DRIE1
+  394.343 DRIE2 +  431.992 DRIE3 +  466.46  DRIE4  +  497.746 DRIE5
+  525.85  DRIE6 +  550.772 DRIE7 +  572.513 DRIE8  +  591.073 DRIE9
+  606.451 DRIE10+  618.647 DRIE11+ 0.003478 EXCTF  + .000361  EXRIO
+ .000529  EXVEG + .000617  EXFRU
```

SUBJECT TO

NATIONAL DOMESTIC CONSUMPTION

```
NDCRIB) - 0.99 MPURIB - 0.99 MBARIB - 0.99 MNPRIB + 419492.7 DRIB1
   + 461442 DRIB2 + 503391.2 DRIB3 + 545340.5 DRIB4 + 587289.8 DRIB5
   + 629239 DRIB6 + 671188.3 DRIB7 + 713137.6 DRIB8 + 755086.9 DRIB9
   + 797036.1 DRIB10 + 838985.4 DRIB11 <=   0

NDCRIO) - 0.99 MPURIO - 0.99 MSIRIO - 0.99 MBARIO - 0.99 MNPRIO
   + 1139224.9 DRIO1 + 1212460.8 DRIO2 + 1285696.7 DRIO3
   + 1358932.5 DRIO4 + 1432168.4 DRIO5 + 1505404.3 DRIO6
   + 1578640.2 DRIO7 + 1651876 DRIO8 + 1725111.9 DRIO9 + 1798347.8 DRIO10
   + 1871583.7 DRIO11 <=   0

NDCCOG) - 0.809 MPUCOG - 0.809 MSICOG - 0.809 MBACOG - 0.809 MNPCOG
   + 620400 DCOG1 + 682440 DCOG2 + 744480 DCOG3 + 806520 DCOG4
   + 868560 DCOG5 + 930600 DCOG6 + 992640 DCOG7 + 1054680 DCOG8
   + 1116720 DCOG9 + 1178760 DCOG10 + 1240800 DCOG11 <=   0

NDCCTF) - 0.845 MPUCOT - 0.845 MSICTF - 0.845 MNPCOT + 42450 DCTF2
   + 84900 DCTF3 + 127350 DCTF4 + 169800 DCTF5 + 212250 DCTF6
   + 254700 DCTF7 + 297150 DCTF8 + 339600 DCTF9 + 382050 DCTF10
   + 424500 DCTF11 <=   0

NDCSUG) - 0.082 MPUSUG - 0.09 MSISUG - 0.087 MBASUG - 0.087 MNPSUG
   + 2056395 DSUG1 + 2159214.8 DSUG2 + 2262034.5 DSUG3 + 2364854.3 DSUG4
   + 2467674 DSUG5 + 2570493.8 DSUG6 + 2673313.5 DSUG7 + 2776133.3 DSUG8
   + 2878953 DSUG9 + 2981772.8 DSUG10+ 3084592.5 DSUG11- 0.95 MIRSUG <=   0
```


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NDCPUL) - 0.83 MPUPUL - 0.83 MSIPUL - 0.83 MBAPUL - 0.83 MNPPUL
    + 367376 DPUL1 + 397022.6 DPUL2 + 426669.2 DPUL3 + 456315.9 DPUL4
    + 485962.4 DPUL5 + 515609 DPUL6 + 545255.7 DPUL7 + 574902.2 DPUL8
    + 604548.9 DPUL9 + 634195.4 DPUL10 + 663842 DPUL11 - 0.98 MIRPUL
    <=   0

NDCVEG) - 0.91 MPUVEG - 0.91 MSIVEG - 0.91 MBAVEG - 0.91 MNPVEG
    + 2217675.5 DVEG1 + 2328559.3 DVEG2 + 2439443 DVEG3 + 2550326.8 DVEG4
    + 2661210.5 DVEG5 + 2772094.3 DVEG6 + 2882978 DVEG7 + 2993862 DVEG8
    + 3104745.8 DVEG9 + 3215629.5 DVEG10 + 3326513.3 DVEG11 <=   0

NDCFRU) - 0.87 MPUFRU - 0.87 MSIFRU - 0.87 MBAFRU - 0.87 MNPFRU
    + 2255595 DFRU1 + 2368374.8 DFRU2 + 2481154.5 DFRU3 + 2593934.3 DFRU4
    + 2706714 DFRU5 + 2819493.8 DFRU6 + 2932273.5 DFRU7 + 3045053.3 DFRU8
    + 3157833 DFRU9 + 3270612.8 DFRU10 + 3383392.5 DFRU11 <=   0

NDCWHE) - 0.82 MPUWHE - 0.82 MSIWHE - 0.82 MBAWHE - 0.82 MNPWHE
    + 7183029 DWHE1 + 7644795 DWHE2 + 8106561.5 DWHE3 + 8568327 DWHE4
    + 9030094 DWHE5 + 9491860 DWHE6 + 9953626 DWHE7 + 10415392 DWHE8
    + 10877158 DWHE9 + 11338924 DWHE10 + 11800690 DWHE11 - 0.82 MIRWHE
    <=   0

NDCVGE)   510530.4 DVGE1 + 612042.9 DVGE2 + 713555.3 DVGE3
    + 815067.8 DVGE4 + 916580.2 DVGE5 + 1018092.7 DVGE6 + 1119605 DVGE7
    + 1221117.5 DVGE8 + 1322629.9 DVGE9 + 1424142.4 DVGE10
    + 1525654.8 DVGE11 - 0.3 VGDTOL - 0.32 VGDNOL - 0.09 VGDCTS
    - 0.97 VGESOY - 0.97 VGEPAL <=   0

NDCLOI)   25443.1 DLOI1 + 30502.14 DLOI2 + 35561.17 DLOI3 + 40620.21 DLOI4
    + 45679.24 DLOI5 + 50738.28 DLOI6 + 55797.31 DLOI7 + 60856.35 DLOI8
    + 65915.39 DLOI9 + 70974.42 DLOI10 + 76033.46 DLOI11 - 0.3 LOITOL
    - 0.32 LOINOL - 0.09 LOICTS - 0.97 LOISOY - 0.97 LOIPAL <=   0

NDCBEE) - 0.45 MPUNMC - 0.45 MSINMC - 0.45 MBANMC - 0.45 MNPNMC
    + 113000 DBEE1 + 185300 DBEE2 + 257600 DBEE3 + 329900 DBEE4
    + 402200 DBEE5 + 474500 DBEE6 + 546800 DBEE7 + 619100 DBEE8
    + 691400 DBEE9 + 763700 DBEE10 + 836000 DBEE11 <=   0

NDCMIL) - 1.22 MPUMCA - 1.22 MSIMCA - 1.22 MBAMCA - 1.22 MNPMCA
    + 3565922.3 DMIL1 + 5041892.5 DMIL2 + 6517862.5 DMIL3
    + 7993832.5 DMIL4 + 9469803 DMIL5 + 10945773 DMIL6 + 12421743 DMIL7
    + 13897713 DMIL8 + 15373683 DMIL9 + 16849654 DMIL10 + 18325624 DMIL11
    - MIRMIL <=   0

NDCBUT) - MPUBUT - MSIBUT - MBABUT - MNPBUT + 27950 DBUT1 + 33507.5 DBUT2
    + 39065 DBUT3 + 44622.5 DBUT4 + 50180 DBUT5 + 55737.5 DBUT6
    + 61295 DBUT7 + 66852.5 DBUT8 + 72410 DBUT9 + 77967.5 DBUT10
    + 83525 DBUT11 <=   0

NDCAGE) - 0.053 MPUAGE - 0.053 MSIAGE - 0.053 MBAAGE - 0.053 MNPAGE
    + 50740 DAGE1 + 60829 DAGE2 + 70918 DAGE3 + 81007 DAGE4 + 91096 DAGE5
    + 101185 DAGE6 + 111274 DAGE7 + 121363 DAGE8 + 131452 DAGE9
    + 141541 DAGE10 + 151630 DAGE11 <=   0

NDCMUT) - 0.45 MPUGOS - 0.45 MSIGOS - 0.45 MBAGOS - 0.45 MNPGOS
    + 57000 DMUT1 + 133900 DMUT2 + 210900 DMUT3 + 287900 DMUT4
    + 364800 DMUT5 + 441800 DMUT6 + 518700 DMUT7 + 595600 DMUT8
    + 672600 DMUT9 + 749600 DMUT10 + 826500 DMUT11 <=   0

NDCPOU) - 0.99 MPUPOU - 0.99 MSIPOU - 0.99 MBAPOU - 0.99 MNPPOU
    + 22869 DPOU2 + 45738 DPOU3 + 68607 DPOU4 + 91476 DPOU5 + 114345 DPOU6
    + 137214 DPOU7 + 160083 DPOU8 + 182952 DPOU9 + 205821 DPOU10 + 228690
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      DPOU11 <=   0

NDCEGG) - 0.98 MPUEGG - 0.98 MSIEGG - 0.98 MBAEGG - 0.98 MNPEGG
   + 1704024 DEGG1 + 2057000.4 DEGG2 + 2409976.8 DEGG3 + 2762953.3 DEGG4
   + 3115929.5 DEGG5 + 3468906 DEGG6 + 3821882.5 DEGG7 + 4174858.8 DEGG8
   + 4527835 DEGG9 + 4880811.5 DEGG10 + 5233788 DEGG11 <=   0
```

NATIONAL PROCESSING OF VEGETABLE GHEE

```
PROSOY)   VGESOY + LOISOY - 0.98 MIPSOY <=   0

PROPAL)   VGEPAL + LOIPAL - 0.98 MIPPAL <=   0
```

EXPORT AND IMPORT BALANCES

```
NDCRIE) - 0.99 MXPRIB + 110000 DRIE1 + 126500 DRIE2 + 143000 DRIE3
   + 159500 DRIE4 + 176000 DRIE5 + 192500 DRIE6 + 209000 DRIE7
   + 225500 DRIE8 + 242000 DRIE9 + 258500 DRIE10 + 275000 DRIE11
   <=   0

EXBRIO) - 0.99 MXPRIO - 0.99 MXSRIO + EXRIO <=   0

EXBCTF) - 0.93 MXPCTF - 0.93 MXSCTF + EXCTF <=   0

EXBVEG) - 0.91 MXPVEG - 0.91 MXSVEG - 0.91 MXBVEG - 0.91 MXNVEG + EXVEG
   <=   0

EXBFRU) - 0.87 MXPFRU - 0.87 MXSFRU - 0.87 MXBFRU - 0.87 MXNFRU + EXFRU
   <=   0

IMBSUG)   MIRSUG - IMSUG <=   0

IMBPUL)   MIRPUL - IMPUL <=   0

IMBWHE)   MIRWHE - IMWHE <=   0

IMBSOYO)  MIPSOY - IMSOYO <=   0

IMBPALO)  MIPPAL - IMPALO <=   0

IMBMIL)   MIRMIL - IMMIL <=   0
```

Farm Income Accounting Row

```
FARMINC)   0.692 DRIB1 + 0.704 DRIB2 + 0.706 DRIB3 + 0.697 DRIB4
   + 0.678 DRIB5 + 0.649 DRIB6 + 0.609 DRIB7 + 0.559 DRIB8 + 0.498 DRIB9
   + 0.427 DRIB10 + 0.346 DRIB11 + 0.868 DRIO1 + 0.855 DRIO2
   + 0.833 DRIO3 + 0.803 DRIO4 + 0.764 DRIO5 + 0.717 DRIO6 + 0.662 DRIO7
   + 0.598 DRIO8 + 0.526 DRIO9 + 0.445 DRIO10 + 0.357 DRIO11
   + 0.399 DCOG1 + 0.406 DCOG2 + 0.407 DCOG3 + 0.402 DCOG4 + 0.391 DCOG5
   + 0.374 DCOG6 + 0.351 DCOG7 + 0.322 DCOG8 + 0.287 DCOG9 + 0.246 DCOG10
   + 0.199 DCOG11 + 1.157 DCTF2 + 2.126 DCTF3 + 2.908 DCTF4 + 3.502 DCTF5
   + 3.809 DCTF6 + 4.128 DCTF7 + 4.159 DCTF8 + 4.003 DCTF9 + 3.659 DCTF10
   + 3.127 DCTF11 + 3.507 DSUG1 + 3.407 DSUG2 + 3.279 DSUG3 + 3.126 DSUG4
   + 2.946 DSUG5 + 2.74 DSUG6 + 2.508 DSUG7 + 2.249 DSUG8 + 1.964 DSUG9
   + 1.653 DSUG10 + 1.315 DSUG11 + 0.558 DPUL1 + 0.558 DPUL2
   + 0.551 DPUL3 + 0.537 DPUL4 + 0.517 DPUL5 + 0.49 DPUL6 + 0.456 DPUL7
   + 0.415 DPUL8 + 0.367 DPUL9 + 0.313 DPUL10 + 0.252 DPUL11
   + 2.342 DVEG1 + 2.275 DVEG2 + 2.19 DVEG3 + 2.087 DVEG4 + 1.967 DVEG5
   + 1.83 DVEG6 + 1.674 DVEG7 + 1.502 DVEG8 + 1.311 DVEG9 + 1.104 DVEG10
   + 0.878 DVEG11 + 3.276 DFRU1 + 3.182 DFRU2 + 3.063 DFRU3 + 2.92 DFRU4
```

```
+ 2.752 DFRU5 + 2.559 DFRU6 + 2.342 DFRU7 + 2.101 DFRU8 + 1.834 DFRU9
+ 1.544 DFRU10 + 1.228 DFRU11 + 3.725 DWHE1 + 3.667 DWHE2
+ 3.573 DWHE3 + 3.444 DWHE4 + 3.278 DWHE5 + 3.076 DWHE6 + 2.839 DWHE7
+ 2.566 DWHE8 + 2.256 DWHE9 + 1.911 DWHE10 + 1.53 DWHE11 + 1.686 DVGE1
+ 1.869 DVGE2 + 2.003 DVGE3 + 2.086 DVGE4 + 2.119 DVGE5 + 2.101 DVGE6
+ 2.033 DVGE7 + 1.915 DVGE8 + 1.747 DVGE9 + 1.528 DVGE10
+ 1.259 DVGE11 + 0.087 DLOI1 + 0.096 DLOI2 + 0.103 DLOI3 + 0.107 DLOI4
+ 0.109 DLOI5 + 0.108 DLOI6 + 0.104 DLOI7 + 0.098 DLOI8 + 0.09 DLOI9
+ 0.078 DLOI10 + 0.06499999 DLOI11 + 0.382 DBEE1 + 0.58 DBEE2
+ 0.741 DBEE3 + 0.865 DBEE4 + 0.952 DBEE5 + 1.003 DBEE6 + 1.017 DBEE7
+ 0.995 DBEE8 + 0.935 DBEE9 + 0.839 DBEE10 + 0.707 DBEE11
+ 4.268 DMIL1 + 5.582 DMIL2 + 6.632 DMIL3 + 7.416 DMIL4 + 7.935 DMIL5
+ 8.189 DMIL6 + 8.178 DMIL7 + 7.902 DMIL8 + 7.361 DMIL9 + 6.555 DMIL10
+ 5.484 DMIL11 + 0.268 DBUT1 + 0.297 DBUT2 + 0.319 DBUT3 + 0.332 DBUT4
+ 0.337 DBUT5 + 0.334 DBUT6 + 0.324 DBUT7 + 0.305 DBUT8 + 0.278 DBUT9
+ 0.243 DBUT10 + 0.2 DBUT11 + 0.501 DAGE1 + 0.556 DAGE2 + 0.596 DAGE3
+ 0.62 DAGE4 + 0.63 DAGE5 + 0.625 DAGE6 + 0.605 DAGE7 + 0.57 DAGE8
+ 0.519 DAGE9 + 0.454 DAGE10 + 0.375 DAGE11 + 0.418 DMUT1 + 0.91 DMUT2
+ 1.316 DMUT3 + 1.638 DMUT4 + 1.875 DMUT5 + 2.027 DMUT6 + 2.095 DMUT7
+ 2.077 DMUT8 + 1.975 DMUT9 + 1.789 DMUT10 + 1.517 DMUT11
+ 0.104 DPOU2 + 0.192 DPOU3 + 0.262 DPOU4 + 0.316 DPOU5 + 0.353 DPOU6
+ 0.372 DPOU7 + 0.375 DPOU8 + 0.361 DPOU9 + 0.33 DPOU10 + 0.282 DPOU11
+ 0.314 DEGG1 + 0.35 DEGG2 + 0.377 DEGG3 + 0.394 DEGG4 + 0.401 DEGG5
+ 0.399 DEGG6 + 0.387 DEGG7 + 0.365 DEGG8 + 0.333 DEGG9 + 0.292 DEGG10
+ 0.241 DEGG11 + 0.283 DRIE1 + 0.301 DRIE2 + 0.313 DRIE3 + 0.318 DRIE4
+ 0.317 DRIE5 + 0.309 DRIE6 + 0.296 DRIE7 + 0.275 DRIE8 + 0.249 DRIE9
+ 0.216 DRIE10 + 0.177 DRIE11 - AFARMI <=   0
```

CONVEX COMBINATION CONSTRAINTS

```
CCCRIE)   DRIE1 + DRIE2 + DRIE3 + DRIE4 + DRIE5 + DRIE6 + DRIE7 + DRIE8
   + DRIE9 + DRIE10 + DRIE11 <=   1

CCCRIB)   DRIB1 + DRIB2 + DRIB3 + DRIB4 + DRIB5 + DRIB6 + DRIB7 + DRIB8
   + DRIB9 + DRIB10 + DRIB11 <=   1

CCCRIO)   DRIO1 + DRIO2 + DRIO3 + DRIO4 + DRIO5 + DRIO6 + DRIO7 + DRIO8
   + DRIO9 + DRIO10 + DRIO11 <=   1


CCCCOG)   DCOG1 + DCOG2 + DCOG3 + DCOG4 + DCOG5 + DCOG6 + DCOG7 + DCOG8
   + DCOG9 + DCOG10 + DCOG11 <=   1

CCCCTF)   DCTF1 + DCTF2 + DCTF3 + DCTF4 + DCTF5 + DCTF6 + DCTF7 + DCTF8
   + DCTF9 + DCTF10 + DCTF11 <=   1

CCCSUG)   DSUG1 + DSUG2 + DSUG3 + DSUG4 + DSUG5 + DSUG6 + DSUG7 + DSUG8
   + DSUG9 + DSUG10 + DSUG11 <=   1

CCCPUL)   DPUL1 + DPUL2 + DPUL3 + DPUL4 + DPUL5 + DPUL6 + DPUL7 + DPUL8
   + DPUL9 + DPUL10 + DPUL11 <=   1

CCCVEG)   DVEG1 + DVEG2 + DVEG3 + DVEG4 + DVEG5 + DVEG6 + DVEG7 + DVEG8
   + DVEG9 + DVEG10 + DVEG11 <=   1

CCCFRU)   DFRU1 + DFRU2 + DFRU3 + DFRU4 + DFRU5 + DFRU6 + DFRU7 + DFRU8
   + DFRU9 + DFRU10 + DFRU11 <=   1

CCCWHE)   DWHE1 + DWHE2 + DWHE3 + DWHE4 + DWHE5 + DWHE6 + DWHE7 + DWHE8
   + DWHE9 + DWHE10 + DWHE11 <=   1

CCCVGE)   DVGE1 + DVGE2 + DVGE3 + DVGE4 + DVGE5 + DVGE6 + DVGE7 + DVGE8
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   + DVGE9 + DVGE10 + DVGE11 <=   1

CCCLOI)   DLOI1 + DLOI2 + DLOI3 + DLOI4 + DLOI5 + DLOI6 + DLOI7 + DLOI8
   + DLOI9 + DLOI10 + DLOI11 <=   1

CCCBEE)   DBEE1 + DBEE2 + DBEE3 + DBEE4 + DBEE5 + DBEE6 + DBEE7 + DBEE8
   + DBEE9 + DBEE10 + DBEE11 <=   1

CCCMIL)   DMIL1 + DMIL2 + DMIL3 + DMIL4 + DMIL5 + DMIL6 + DMIL7 + DMIL8
   + DMIL9 + DMIL10 + DMIL11 <=   1

CCCMUT)   DBUT1 + DBUT2 + DBUT3 + DBUT4 + DBUT5 + DBUT6 + DBUT7 + DBUT8
   + DBUT9 + DBUT10 + DBUT11 <=   1

CCCAGE)   DAGE1 + DAGE2 + DAGE3 + DAGE4 + DAGE5 + DAGE6 + DAGE7 + DAGE8
   + DAGE9 + DAGE10 + DAGE11 <=   1

CCCBUT)   DMUT1 + DMUT2 + DMUT3 + DMUT4 + DMUT5 + DMUT6 + DMUT7 + DMUT8
   + DMUT9 + DMUT10 + DMUT11 <=   1

CCCPOU)   DPOU1 + DPOU2 + DPOU3 + DPOU4 + DPOU5 + DPOU6 + DPOU7 + DPOU8
   + DPOU9 + DPOU10 + DPOU11 <=   1

CCCEGG)   DEGG1 + DEGG2 + DEGG3 + DEGG4 + DEGG5 + DEGG6 + DEGG7 + DEGG8
   + DEGG9 + DEGG10 + DEGG11 <=   1

            PUNJAB PRODUCTION ROWS

PUPRIB) - 971.5333 PS1RIB - 1023.534 PM1RIB - 1018.334 PL1RIB
   - 947.2667 PS2RIB - 997.5333 PM2RIB - 993.2 PL2RIB - 1069.467 PS3RIB
   - 1125.8 PM3RIB - 1120.6 PL3RIB + MPURIB + MXPRIB <=   0

PUPRIO) - 2113.2 PS1RIO - 2223 PM1RIO - 2211.3 PL1RIO - 2203.2 PS2RIO
   - 2318.4 PM2RIO - 2306.7 PL2RIO - 1713.6 PS3RIO - 1802.7 PM3RIO
   - 1793.7 PL3RIO + MPURIO + MXPRIO <=   0

PUPCOG) - 474.0432 PS1COG - 643.5852 PS1BAR - 555.8926 PM1COG
   - 650.6887 PM1BAR - 493.005 PL1COG - 676.2617 PL1BAR - 874.3792 PS2COG
   - 666.107 PS2BAR - 918.0982 PM2COG - 673.4592 PM2BAR - 909.3544 PL2COG
   - 699.927 PL2BAR - 662.1776 PS3COG - 582.9219 PS3BAR - 695.2865 PM3COG
   - 589.3559 PM3BAR - 588.6647 PL3COG - 612.5184 PL3BAR + MPUCOG
   <=   0

PUPCOT) - 163.587 PS1CO3 - 179.955 PS1CO4 - 162.006 PM1CO3
   - 178.281 PM1CO4 - 174.84 PL1CO3 - 192.324 PL1CO4 - 283.743 PS2CO3
   - 312.108 PS2CO4 - 281.046 PM2CO3 - 309.132 PM2CO4 - 303.18 PL2CO3
   - 333.498 PL2CO4 - 767.715 PS3CO3 - 844.533 PS3CO4 - 760.275 PM3CO3
   - 836.256 PM3CO4 - 820.167 PL3CO3 - 902.193 PL3CO4 + MPUCOT + MXPCTF
   <=   0

PUPSUG) - 34280 PS1SUG - 35531 PM1SUG - 34533 PL1SUG - 38716 PS2SUG
   - 40129 PM2SUG - 39002 PL2SUG - 32280 PS3SUG - 32280 PM3SUG
   - 32518 PL3SUG + MPUSUG <=   0

PUPTOL) - 414.7398 PS1TOK - 893.9482 PS1TOR - 319.0306 PM1TOK
   - 687.6525 PM1TOR - 506.9042 PL1TOK - 1092.604 PL1TOR
   - 885.2032 PS2TOK - 885.2 PS2TOR - 680.9255 PM2TOK - 680.9 PM2TOR
   - 680.9255 PL2TOK - 680.9 PL2TOR - 887.5949 PS3TOK - 988.7246 PS3TOR
   - 682.7653 PM3TOK - 760.5573 PM3TOR - 1084.838 PL3TOK
   - 1208.441 PL3TOR + MPUTOL <=   0

PUPNOK) - 1097.853 PS1NOK - 844.5023 PM1NOK - 1341.821 PL1NOK
```

```
   - 1250.604 PS2NOK - 962.0027 PM2NOK - 962.0027 PL2NOK
   - 997.7653 PS3NOK - 767.5118 PM3NOK - 1219.491 PL3NOK + MPUNOK
   <=   0

PUPPUL) - 344.9086 PS1PUK - 277.7412 PS1PUR - 265.3143 PM1PUK
   - 280.8067 PM1PUR - 421.555 PL1PUK - 291.8428 PL1PUR - 375.2939 PS2PUK
   - 246.335 PS2PUR - 375.2939 PM2PUK - 249.0539 PM2PUR - 458.6925 PL2PUK
   - 258.842 PL2PUR - 410.1893 PS3PUK - 271.8417 PS3PUR - 315.5302 PM3PUK
   - 274.8421 PM3PUR - 501.3424 PL3PUK - 285.6438 PL3PUR + MPUPUL
   <=   0


PUPHVA) - 16697.45 PS1VEK - 5127.141 PS1HVA - 15397.65 PM1VEK
   - 4728.022 PM1HVA - 12398.11 PL1VEK - 3806.979 PL1HVA
   - 16980.86 PS2VEK - 6930.429 PS2HVA - 15659 PM2VEK - 6390.935 PM2HVA
   - 12608.54 PL2VEK - 5145.947 PL2HVA - 14237.49 PS3VEK
   - 5959.952 PS3HVA - 13129.18 PM3VEK - 5496.004 PM3HVA
   - 10571.55 PL3VEK - 4425.354 PL3HVA + MPUVEG + MXPVEG <=   0

PUPWHE) - 1429.538 PS1WHE - 1358.061 PS1WHL - 1445.316 PM1WHE
   - 1373.051 PM1WHL - 1502.119 PL1WHE - 1427.013 PL1WHL
   - 1493.398 PS2WHE - 1418.728 PS2WHL - 1509.881 PM2WHE
   - 1434.387 PM2WHL - 1569.221 PL2WHE - 1490.76 PL2WHL - 1520.366 PS3WHE
   - 1444.347 PS3WHB - 1537.147 PM3WHE - 1460.29 PM3WHB - 1597.559 PL3WHE
   - 1517.681 PL3WHB + MPUWHE <=   0

PUPNOR) - 1076.224 PS1NOR - 827.8648 PM1NOR - 1315.385 PL1NOR
   - 1078.789 PS2NOR - 829.8378 PM2NOR - 1318.52 PL2NOR - 1053.414 PS3NOR
   - 810.3179 PM3NOR - 1287.505 PL3NOR + MPUNOR <=   0

PUPFRU) - 7403.693 PS1FRU - 7331.462 PM1FRU - 7909.311 PL1FRU
   - 8734.649 PS2FRU - 8649.432 PM2FRU - 9331.161 PL2FRU - 7905.93 PS3FRU
   - 7828.8 PM3FRU - 8445.848 PL3FRU + MPUFRU + MXPFRU <=   0

PUPMCA) - 1075 L1MCA1 - 1183 L1MCA2 - 1129 LIMCA3 - 1075 L2MCA1
   - 1183 L2MCA2 - 1129 L2MCA3 - 1075 L3MCA1 - 1183 L3MCA2 - 1129 L3MCA3
   + MPUMCA + MPUBUT + MPUAGE <=   0

PUPNMC) - 167 L1NMC1 - 183.7 L1NMC2 - 175.4 L1NMC3 - 167 L2NMC1
   - 183.7 L2NMC2 - 175.4 L2NMC3 - 167 L3NMC1 - 183.7 L3NMC2
   - 175.4 L3NMC3 + MPUNMC <=   0

PUPGOS) - 164 L1GOS1 - 180.4 L1GOS2 - 172.2 L1GOS3 - 164 L2GOS1
   - 180.4 L2GOS2 - 172.2 L2GOS3 - 164 L3GOS1 - 180.4 L3GOS2
   - 172.2 L3GOS3 + MPUGOS <=   0

PUPPOU) - 0.909 L1BRO1 - 0.909 L1BRO2 - 1.092 L1BRO3 - 0.909 L1BRO4
   - 1.364 L1LAY1 - 1.364 L1LAY2 - 1.638 L1LAY3 - 1.364 L1LAY4
   - 1.136 L1DESI - 0.909 L2BRO1 - 0.909 L2BRO2 - 1.092 L2BRO3
   - 0.909 L2BRO4 - 1.364 L2LAY1 - 1.364 L2LAY2 - 1.638 L2LAY3
   - 1.364 L2LAY4 - 1.136 L2DESI - 0.909 L3BRO1 - 0.909 L3BRO2
   - 1.092 L3BRO3 - 0.909 L3BRO4 - 1.364 L3LAY1 - 1.364 L3LAY2
   - 1.638 L3LAY3 - 1.364 L3LAY4 - 1.136 L3DESI + MPUPOU <=   0

PUPEGG) - 133 L1LAY1 - 133 L1LAY2 - 160 L1LAY3 - 133 L1LAY4 - 89 L1DESI
   - 133 L2LAY1 - 133 L2LAY2 - 160 L2LAY3 - 133 L2LAY4 - 89 L2DESI
   - 133 L3LAY1 - 133 L3LAY2 - 160 L3LAY3 - 133 L3LAY4 - 89 L3DESI
   + MPUEGG <=   0
```

PUNJAB INPUT BALANCES

```
PUIFEN)   A1FENK + A1FENR + A2FENK + A2FENR + A3FENK + A3FENR - IPUFEN
   <=   0

PUIFEP)   A1FEPK + A1FEPR + A2FEPK + A2FEPR + A3FEPK + A3FEPR - IPUFEP
   <=   0

PUIFEK)   A1FEKK + A1FEKR + A2FEKK + A2FEKR + A3FEKK + A3FEKR - IPUFEK
   <=   0

 PUIHL)   APUHLK + APUHLR - IPUHL <=   0

PUITTR)   4.752 PS1COG + 6.31845 PS1CO3 + 6.95029 PS1CO4 + 1.53886 PS1TOK
   + 5.226 PS1NOK + 2.33337 PS1PUK + 7.602 PS1VEK + 2.373 PS1FDK
   + 3.11809 PS1BAR + 5.6833 PS1PUR + 10.3782 PS1HVA + 6.30105 PS1TOR
   + 5.226 PS1NOR + 2.373 PS1FDR + 63.85 PS1FRU + 4.942 PM1RIB
   + 13.5905 PM1RIO + 6.336 PM1COG + 9.01146 PM1CO3 + 9.9126 PM1CO4
   + 14.826 PM1SUG + 2.05182 PM1TOK + 6.968 PM1NOK + 3.11116 PM1PUK
   + 10.136 PM1VEK + 3.164 PM1FDK + 6.93115 PM1WHE + 6.58459 PM1WHL
   + 4.15745 PM1BAR + 7.57773 PM1PUR + 13.8376 PM1HVA + 8.4014 PM1TOR
   + 6.968 PM1NOR + 3.164 PM1FDR + 85.13 PM1FRU + 12.40442 PL1RIB
   + 12.18203 PL1RIO + 7.92 PL1COG + 11.70447 PL1CO3 + 12.87492 PL1CO4
   + 23.69689 PL1SUG + 2.56477 PL1TOK + 8.71 PL1NOK + 3.88895 PL1PUK
   + 12.67 PL1VEK + 3.955 PL1FDK + 12.04118 PL1WHE + 11.43912 PL1WHL
   + 5.19682 PL1BAR + 9.47216 PL1PUR + 17.297 PL1HVA + 10.50175 PL1TOR
   + 8.71 PL1NOR + 3.955 PL1FDR + 106.42 PL1FRU + 0.59304 PS2RIB
   + 9.978 PS2RIO + 1.53886 PS2TOK + 5.226 PS2NOK + 2.33337 PS2PUK
   + 7.602 PS2VEK + 2.373 PS2FDK + 3.11809 PS2BAR + 5.6833 PS2PUR
   + 10.3782 PS2HVA + 6.30105 PS2TOR + 5.226 PS2NOR + 2.373 PS2FDR
   + 63.85 PS2FRU + 3.01462 PM2RIB + 13.304 PM2RIO + 8.05546 PM2COG
   + 10.56352 PM2CO3 + 11.61987 PM2CO4 + 8.62379 PM2SUG + 2.05182 PM2TOK
   + 6.968 PM2NOK + 3.11115 PM2PUK + 10.136 PM2VEK + 3.164 PM2FDK
   + 6.6 PM2WHE + 6.27 PM2WHL + 4.15745 PM2BAR + 7.57773 PM2PUR
   + 13.8376 PM2HVA + 8.4014 PM2TOR + 6.968 PM2NOR + 3.164 PM2FDR
   + 85.13 PM2FRU + 7.14119 PL2RIB + 16.63 PL2RIO + 15.36962 PL2COG
   + 25.82195 PL2CO3 + 28.40414 PL2CO4 + 22.239 PL2SUG + 2.56477 PL2TOK
   + 8.71 PL2NOK + 3.88895 PL2PUK + 12.67 PL2VEK + 3.955 PL2FDK
   + 12.50326 PL2WHE + 11.87809 PL2WHL + 5.19682 PL2BAR + 9.47216 PL2PUR
   + 17.297 PL2HVA + 10.50175 PL2TOR + 8.71 PL2NOR + 3.955 PL2FDR
   + 106.42 PL2FRU + 0.59304 PS3RIB + 9.978 PS3RIO + 36.50284 PS3CO3
   + 40.15313 PS3CO4 + 58.0685 PS3SUG + 1.53886 PS3TOK + 5.226 PS3NOK
   + 2.33337 PS3PUK + 7.602 PS3VEK + 2.373 PS3FDK + 6.79525 PS3WHE
   + 6.45548 PS3WHB + 3.11809 PS3BAR + 5.6833 PS3PUR + 12.72565 PS3HVA
   + 6.30105 PS3TOR + 5.226 PS3NOR + 2.373 PS3FDR + 63.85 PS3FRU
   + 5.6833 PM3RIB + 8.52495 PM3RIO + 4.942 PM3COG + 9.17853 PM3CO3
   + 10.09638 PM3CO4 + 29.42961 PM3SUG + 2.05182 PM3TOK + 6.968 PM3NOK
   + 3.11116 PM3PUK + 10.136 PM3VEK + 3.164 PM3FDK + 6.36035 PM3WHE
   + 6.04233 PM3WHB + 4.15745 PM3BAR + 7.57773 PM3PUR + 14.25767 PM3HVA
   + 8.4014 PM3TOR + 6.968 PM3NOR + 3.164 PM3FDR + 85.13 PM3FRU
   + 5.21381 PL3RIB + 16.63 PL3RIO + 18.87844 PL3CO3 + 20.76628 PL3CO4
   + 2.56477 PL3TOK + 8.71 PL3NOK + 3.88895 PL3PUK + 12.67 PL3VEK
   + 3.955 PL3FDK + 11.17139 PL3WHE + 10.61282 PL3WHB + 5.19682 PL3BAR
   + 9.47216 PL3PUR + 16.01208 PL3HVA + 10.50175 PL3TOR + 8.71 PL3NOR
   + 3.955 PL3FDR + 106.42 PL3FRU - IPUTTR <=   0
```

PUNJAB REGIONAL RESOURCE RESTRICTIONS

```
PURHLK)   60.1775 PS1RIB + 86.9792 PS1RIO + 108.724 PS1COG
   + 116.4335 PS1CO3 + 128.0769 PS1CO4 + 264.1069 PS1TOK
   + 173.9584 PS1NOK + 75.1184 PS1PUK + 193.7264 PS1VEK + 181.9645 PS1FDK
   + 25 PS1FRU + 88.33825 PM1RIB + 158.144 PM1RIO + 158.144 PM1COG
```


281

```
    + 175.0259 PM1CO3 + 192.5285 PM1CO4 + 528.2138 PM1TOK
    + 267.8564 PM1NOK + 119.6755 PM1PUK + 271.81 PM1VEK + 382.2143 PM1FDK
    + 70.27 PM1FRU + 109.1194 PL1RIB + 59.304 PL1RIO + 216.4596 PL1COG
    + 205.6366 PL1CO3 + 226.2003 PL1CO4 + 112.9494 PL1SUG
    + 897.9634 PL1TOK + 370.65 PL1NOK + 174.1166 PL1PUK + 356.8124 PL1VEK
    + 752.5678 PL1FDK + 231.075 PL1FRU + 211.3693 PS2RIB + 134.4224 PS2RIO
    + 39.536 PS2COG + 112.6776 PS2CO3 + 123.9454 PS2CO4 + 264.1069 PS2TOK
    + 173.9584 PS2NOK + 75.1184 PS2PUK + 193.7264 PS2VEK + 181.9645 PS2FDK
    + 25 PS2FRU + 295.2104 PM2RIB + 228.3204 PM2RIO + 29.42951 PM2COG
    + 427.588 PM2CO3 + 470.3468 PM2CO4 + 171.6357 PM2SUG + 528.2138 PM2TOK
    + 267.8564 PM2NOK + 119.6755 PM2PUK + 271.81 PM2VEK + 382.2143 PM2FDK
    + 70.27 PM2FRU + 270.5004 PL2RIB + 310.3576 PL2RIO + 18.2854 PL2COG
    + 563.388 PL2CO3 + 619.7268 PL2CO4 + 289.9224 PL2SUG + 897.9634 PL2TOK
    + 370.65 PL2NOK + 174.1166 PL2PUK + 356.8124 PL2VEK + 752.5678 PL2FDK
    + 231.075 PL2FRU + 196.1727 PS3RIB + 134.4224 PS3RIO + 525.8288 PS3CO3
    + 578.4117 PS3CO4 + 154.4375 PS3SUG + 264.1069 PS3TOK
    + 173.9584 PS3NOK + 75.1184 PS3PUK + 193.7264 PS3VEK + 181.9645 PS3FDK
    + 25 PS3FRU + 298.0273 PM3RIB + 197.68 PM3RIO + 51.891 PM3COG
    + 597.2617 PM3CO3 + 656.9879 PM3CO4 + 134.4224 PM3SUG
    + 528.2138 PM3TOK + 267.8564 PM3NOK + 119.6755 PM3PUK + 271.81 PM3VEK
    + 382.2143 PM3FDK + 70.27 PM3FRU + 298.4474 PL3RIB + 310.3576 PL3RIO
    + 477.8 PL3CO3 + 525.58 PL3CO4 + 988.4 PL3SUG + 897.9634 PL3TOK
    + 370.65 PL3NOK + 174.1166 PL3PUK + 356.8124 PL3VEK + 752.5678 PL3FDK
    + 231.075 PL3FRU - APUHLK <=   0

 PURHLR)   4.4305 PS1WHE + 4.20897 PS1WHL + 71.19148 PS1BAR
    + 15.8144 PS1PUR + 268.8448 PS1HVA + 27.6752 PS1TOR + 173.9584 PS1NOR
    + 181.9645 PS1FDR + 25 PS1FRU + 49.52378 PM1WHE + 47.04759 PM1WHL
    + 82.06833 PM1BAR + 35.0882 PM1PUR + 441.8148 PM1HVA + 60.2924 PM1TOR
    + 267.8564 PM1NOR + 382.2143 PM1FDR + 70.27 PM1FRU + 43.95167 PL1WHE
    + 41.75409 PL1WHL + 100.8568 PL1BAR + 51.891 PL1PUR + 601.9356 PL1HVA
    + 87.9676 PL1TOR + 370.65 PL1NOR + 752.5678 PL1FDR + 231.075 PL1FRU
    + 50.96437 PS2WHE + 48.41615 PS2WHL + 71.19148 PS2BAR + 15.8144 PS2PUR
    + 268.8448 PS2HVA + 27.6752 PS2TOR + 173.9584 PS2NOR + 181.9645 PS2FDR
    + 25 PS2FRU + 81.76044 PM2WHE + 77.67242 PM2WHL + 82.06833 PM2BAR
    + 35.0882 PM2PUR + 441.8148 PM2HVA + 60.2924 PM2TOR + 267.8564 PM2NOR
    + 382.2143 PM2FDR + 70.27 PM2FRU + 56.42775 PL2WHE + 53.60636 PL2WHL
    + 100.8568 PL2BAR + 51.891 PL2PUR + 601.9356 PL2HVA + 87.9676 PL2TOR
    + 370.65 PL2NOR + 752.5678 PL2FDR + 231.075 PL2FRU + 94.86169 PS3WHE
    + 90.1186 PS3WHB + 71.19148 PS3BAR + 15.8144 PS3PUR + 152.8067 PS3HVA
    + 27.6752 PS3TOR + 173.9584 PS3NOR + 181.9645 PS3FDR + 25 PS3FRU
    + 66.59345 PM3WHE + 63.26377 PM3WHB + 82.06833 PM3BAR + 35.0882 PM3PUR
    + 253.6235 PM3HVA + 60.2924 PM3TOR + 267.8564 PM3NOR + 382.2143 PM3FDR
    + 70.27 PM3FRU + 85.72887 PL3WHE + 81.44243 PL3WHB + 100.8568 PL3BAR
    + 51.891 PL3PUR + 263.3098 PL3HVA + 87.9676 PL3TOR + 370.65 PL3NOR
    + 752.5678 PL3FDR + 231.075 PL3FRU - APUHLR <=   0

 PLUHLK)   APUHLK <=   2200000

 PLUHLR)   APUHLR <=   1232038
```

PUNJAB RICE ZONE
SMALL FARM RESOURCE RESTRICTIONS

```
PRSRFALK)   609.0274 PS1RIB + 515.8954 PS1RIO + 197.0888 PS1COG
    + 221.3569 PS1CO3 + 243.4925 PS1CO4 + 1435.972 PS1SUG
    + 797.6753 PS1TOK + 357.8616 PS1NOK + 205.655 PS1PUK + 257.7376 PS1VEK
    + 1678.204 PS1FDK + 313.4 PS1FRU <=   2461195

 PRSRLAK)   PS1RIB + PS1RIO + PS1COG + PS1CO3 + PS1CO4 + PS1SUG + PS1TOK
    + PS1NOK + PS1PUK + PS1VEK + PS1FDK + PS1FRU <=   668
```


282

```
PRSRFALR)   248.9705 PS1WHE + 273.8676 PS1WHL + 187.3328 PS1BAR
     + 121.8203 PS1PUR + 482.3392 PS1HVA + 131.9514 PS1TOR
     + 357.8616 PS1NOR + 1678.204 PS1FDR + 313.41 PS1FRU <=   2461195

 PRSRLAR)   PS1SUG + PS1WHE + PS1WHL + PS1BAR + PS1PUR + PS1HVA + PS1TOR
     + PS1NOR + PS1FDR + PS1FRU <=   847

PRSROBCW)   PS1RIB + PS1CO4 + PS1WHE <=   847

PRSMKTSW)   1868.677 PS1WHE + 1775.243 PS1WHL + HS1WHE >=   796376

PRSMKTSR)   1696.227 PS1RIB + 2661.71 PS1RIO + HS1RIC >=   55877
```

PUNJAB RICE ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

```
PRMRFALK)   581.8217 PM1RIB + 405.244 PM1RIO + 138.0804 PM1COG
     + 145.0451 PM1CO3 + 159.5496 PM1CO4 + 1478.276 PM1SUG
     + 530.8911 PM1TOK + 255.0376 PM1NOK + 156.8139 PM1PUK + 166.428 PM1VEK
     + 1474.989 PM1FDK + 239.49 PM1FRU <=   645751

 PRMRLAK)   PM1RIB + PM1RIO + PM1COG + PM1CO3 + PM1CO4 + PM1SUG + PM1TOK
     + PM1NOK + PM1PUK + PM1VEK + PM1FDK + PM1FRU <=   354

PRMRFALR)   157.0444 PM1WHE + 172.7489 PM1WHL + 176.4559 PM1BAR
     + 84.7553 PM1PUR + 294.5432 PM1HVA + 72.1532 PM1TOR + 255.0376 PM1NOR
     + 1474.989 PM1FDR + 239.49 PM1FRU <=   645751

 PRMRLAR)   PM1SUG + PM1WHE + PM1WHL + PM1BAR + PM1PUR + PM1HVA + PM1TOR
     + PM1NOR + PM1FDR + PM1FRU <=   483

PRMROBCW)   PM1RIB + PM1CO4 + PM1WHE <=   483

PRMMKTSW)   1889.302 PM1WHE + 1794.837 PM1WHL + HM1WHE >=   208948

PRMMKTSR)   1784.572 PM1RIB + 2800.341 PM1RIO + HM1RIC >=   14661
```

PUNJAB RICE ZONE
LARGE FARM RESOURCE RESTRICTIONS

```
PRLRFALK)   429.4104 PL1RIB + 268.2518 PL1RIO + 70.1764 PL1COG
     + 57.27778 PL1CO3 + 63.00555 PL1CO4 + 1411.584 PL1SUG
     + 158.4641 PL1TOK + 143.318 PL1NOK + 98.08881 PL1PUK + 68.1996 PL1VEK
     + 1101.671 PL1FDK + 50 PL1FRU <=   327951

 PRLRLAK)   PL1RIB + PL1RIO + PL1COG + PL1CO3 + PL1CO4 + PL1SUG + PL1TOK
     + PL1NOK + PL1PUK + PL1VEK + PL1FDK + PL1FRU <=   368

PRLRFALR)   82.88846 PL1WHE + 91.1773 PL1WHL + 157.6674 PL1BAR
     + 58.0685 PL1PUR + 119.5964 PL1HVA + 33.1114 PL1TOR + 143.318 PL1NOR
     + 1101.671 PL1FDR + 50 PL1FRU <=   327951

 PRLRLAR)   PL1SUG + PL1WHE + PL1WHL + PL1BAR + PL1PUR + PL1HVA + PL1TOR
     + PL1NOR + PL1FDR + PL1FRU <=   490

PRLROBCW)   PL1RIB + PL1CO4 + PL1WHE <=   490

PRLMKTSW)   1963.554 PL1WHE + 1865.377 PL1WHL + HL1WHE >=   106116

PRLMKTSR)   1775.737 PL1RIB + 2786.477 PL1RIO + HL1RIC >=   7446
```

PUNJAB RICE ZONE
ZONAL RESOURCE RESTRICTIONS

```
PRRFENK)   68.38862 PS1RIB + 44.36728 PS1RIO + 26.90915 PS1COG
    + 59.85645 PS1CO3 + 65.84209 PS1CO4 + 24.9008 PS1SUG + 5.90688 PS1TOK
    + 45.94245 PS1NOK + 162.7676 PS1VEK + 30.19075 PS1FDK
    + 56.33326 PS1FRU + 41.17756 PM1RIB + 21.00226 PM1RIO
    + 26.90915 PM1COG + 59.85645 PM1CO3 + 65.84209 PM1CO4 + 57.0999 PM1SUG
    + 5.90688 PM1TOK + 45.94245 PM1NOK + 162.7676 PM1VEK + 30.19075 PM1FDK
    + 56.33326 PM1FRU + 60.68341 PL1RIB + 68.27048 PL1RIO
    + 26.90915 PL1COG + 59.85645 PL1CO3 + 65.84209 PL1CO4
    + 50.85173 PL1SUG + 5.90688 PL1TOK + 45.94245 PL1NOK + 162.7676 PL1VEK
    + 30.19075 PL1FDK + 56.33326 PL1FRU - A1FENK <=   0

PRRFEPK)   16.65095 PS1RIB + 9.94086 PS1RIO + 12.42608 PS1COG
    + 11.80477 PS1CO3 + 12.98525 PS1CO4 + 6.87576 PS1SUG + 4.14202 PS1TOK
    + 9.0044 PS1NOK + 16.56811 PS1VEK + 3.60176 PS1FDK + 23.07989 PS1FRU
    + 7.70417 PM1RIB + 4.14202 PM1RIO + 12.42608 PM1COG + 11.80477 PM1CO3
    + 12.98525 PM1CO4 + 8.28405 PM1SUG + 4.14202 PM1TOK + 9.0044 PM1NOK
    + 16.56811 PM1VEK + 3.60176 PM1FDK + 23.07989 PM1FRU + 14.00005 PL1RIB
    + 12.42608 PL1RIO + 12.42608 PL1COG + 11.80477 PL1CO3
    + 12.98525 PL1CO4 + 13.00596 PL1SUG + 4.14202 PL1TOK + 9.0044 PL1NOK
    + 16.56811 PL1VEK + 3.60176 PL1FDK + 23.07989 PL1FRU - A1FEPK
    <=   0

PRRFEKK)   2.92162 PS1TOK + 2.92162 PS1VEK + 0.46746 PS1FDK
    + 11.6865 PM1SUG + 2.92162 PM1TOK + 2.92162 PM1VEK + 0.46746 PM1FDK
    + 7.59622 PL1RIB + 5.84325 PL1RIO + 2.92162 PL1TOK + 0.46746 PL1FDK
    - A1FEKK <=   0

PLRFENK)   A1FENK <=   67456

PLRFEPK)   A1FEPK <=   15365.05

PLRFEKK)   A1FEKK <=   2130

PRRBULK)   66.66758 PS1RIB + 51.6439 PS1RIO + 36.968 PS1COG + 26.049 PS1CO3
    + 28.6539 PS1CO4 + 65.4815 PS1SUG + 5.35465 PS1TOK + 37.62 PS1NOK
    + 48.10402 PS1PUK + 26.452 PS1VEK + 5.93 PS1FDK + 57.325 PS1FRU
    + 49.09877 PM1RIB + 4.942 PM1RIO + 28.368 PM1COG + 13.0245 PM1CO3
    + 14.32695 PM1CO4 + 17.297 PM1SUG + 2.67732 PM1TOK + 28.694 PM1NOK
    + 43.82001 PM1PUK + 13.226 PM1VEK + 2.965 PM1FDK + 28.665 PM1FRU
    + 19.768 PL1COG + 74.13 PL1SUG + 19.768 PL1NOK + 39.536 PL1PUK
    <=   415800

PRRFENR)   51.10506 PS1WHE + 56.21557 PS1WHL + 16.57775 PS1BAR
    + 7.45998 PS1PUR + 144.2264 PS1HVA + 53.0488 PS1TOR + 58.02213 PS1NOR
    + 38.12882 PS1FDR + 102.4044 PS1FRU + 50.39636 PM1WHE + 55.436 PM1WHL
    + 21.55107 PM1BAR + 7.45998 PM1PUR + 144.2264 PM1HVA + 53.0488 PM1TOR
    + 58.02213 PM1NOR + 38.12882 PM1FDR + 102.4044 PM1FRU
    + 57.79833 PL1WHE + 63.57816 PL1WHL + 24.86662 PL1BAR + 7.45998 PL1PUR
    + 144.2264 PL1HVA + 53.0488 PL1TOR + 58.02213 PL1NOR + 38.12882 PL1FDR
    + 102.4044 PL1FRU - A1FENR <=   0

PRRFEPR)   19.60478 PS1WHE + 21.56457 PS1WHL + 9.82668 PS1PUR
    + 39.31137 PS1HVA + 19.65337 PS1TOR + 21.36095 PS1NOR + 8.54484 PS1FDR
    + 114.4866 PS1FRU + 18.67001 PM1WHE + 20.53724 PM1WHL
    + 10.24317 PM1PUR + 39.31137 PM1HVA + 19.65337 PM1TOR
    + 21.36095 PM1NOR + 8.54484 PM1FDR + 114.4866 PM1FRU + 22.21706 PL1WHE
    + 24.43367 PL1WHL + 9.82668 PL1PUR + 39.31137 PL1HVA + 19.65337 PL1TOR
    + 21.36095 PL1NOR + 8.54484 PL1FDR + 114.4866 PL1FRU - A1FEPR
    <=   0
```


284

```
PRRFEKR)   10.37069 PS1HVA + 0.41482 PS1FDR + 10.37069 PM1HVA
    + 0.41482 PM1FDR + 9.01473 PL1WHE + 9.9162 PL1WHL + 10.37069 PL1HVA
    + 0.41482 PL1FDR - A1FEKR <=   0

PLRFENR)   A1FENR <=   91505.22

PLRFEPR)   A1FEPR <=   35551.05

PLRFEKR)   A1FEKR <=   3517


PRRBULR)   66.53908 PS1WHE + 63.21213 PS1WHL + 149.7558 PS1BAR
    + 58.5627 PS1PUR + 29.652 PS1HVA + 21.2506 PS1TOR + 37.62 PS1NOR
    + 5.93 PS1FDR + 57.325 PS1FRU + 37.1836 PM1WHE + 35.32442 PM1WHL
    + 149.7558 PM1BAR + 49.6671 PM1PUR + 14.826 PM1HVA + 11.8608 PM1TOR
    + 28.694 PM1NOR + 2.965 PM1FDR + 28.665 PM1FRU + 149.7558 PL1BAR
    + 40.7715 PL1PUR + 2.471 PL1TOR + 19.768 PL1NOR + 28.665 PL1FRU
    <=   415800

 PRRFYM)   28.4165 PS1RIB + 32.123 PS1SUG + 37.065 PS1FDK + 35.3353 PS1WHE
    + 33.56853 PS1WHL + 148.26 PS1HVA + 37.065 PS1FDR + 37.07 PS1FRU
    + 18.23598 PM1RIB + 4.942 PM1RIO + 24.71 PM1SUG + 37.065 PM1FDK
    + 1.35905 PM1WHE + 1.29109 PM1WHL + 148.26 PM1HVA + 37.065 PM1FDR
    + 37.07 PM1FRU + 22.26371 PL1RIB + 29.80026 PL1SUG + 2.471 PL1VEK
    + 37.065 PL1FDK + 4.4305 PL1WHE + 4.20897 PL1WHL + 148.26 PL1HVA
    + 37.065 PL1FDR + 37.07 PL1FRU <=   70000

PRRTOWK)   9.43922 PS1RIB + 9.66161 PS1RIO + 3.4594 PS1COG + 4.57752 PS1CO3
    + 5.03528 PS1CO4 + 4.152 PS1SUG + 1.60615 PS1TOK + 3.77445 PS1NOK
    + 1.60615 PS1PUK + 8.85606 PS1VEK + 4.4478 PS1FDK + 4.831 PS1FRU
    + 9.43922 PM1RIB + 9.66161 PM1RIO + 3.4594 PM1COG + 4.57752 PM1CO3
    + 5.03528 PM1CO4 + 4.151 PM1SUG + 1.60615 PM1TOK + 3.77445 PM1NOK
    + 1.60615 PM1PUK + 8.85606 PM1VEK + 4.4478 PM1FDK + 4.831 PM1FRU
    + 9.43922 PL1RIB + 9.66161 PL1RIO + 3.4594 PL1COG + 4.57752 PL1CO3
    + 5.03528 PL1CO4 + 4.152 PL1SUG + 1.60615 PL1TOK + 3.77445 PL1NOK
    + 1.60615 PL1PUK + 8.85606 PL1VEK + 4.4478 PL1FDK + 4.831 PL1FRU
    - IB1CAK - IB1TUK <=   0

PRRTOWR)   4.153 PS1SUG + 3.58295 PS1WHE + 2.64397 PS1WHL + 3.4594 PS1BAR
    + 1.60615 PS1PUR + 3.7065 PS1HVA + 2.471 PS1TOR + 3.77445 PS1NOR
    + 6.1775 PS1FDR + 4.831 PS1FRU + 4.152 PM1SUG + 3.58295 PM1WHE
    + 2.39687 PM1WHL + 3.4594 PM1BAR + 1.60615 PM1PUR + 3.7065 PM1HVA
    + 2.471 PM1TOR + 3.77445 PM1NOR + 6.1775 PM1FDR + 4.831 PM1FRU
    + 4.151 PL1SUG + 3.58295 PL1WHE + 2.39687 PL1WHL + 3.4594 PL1BAR
    + 1.60615 PL1PUR + 3.7065 PL1HVA + 2.471 PL1TOR + 3.77445 PL1NOR
    + 6.1775 PL1FDR + 4.831 PL1FRU - IB1CAR - IB1TUR <=   0

PRRCAWK)   IB1CAK <=   6049

PRRCAWR)   IB1CAR <=   2841

PRRTUWK)   IB1TUK <=   5510

PRRTUWR)   IB1TUR <=   5240
```

PUNJAB RICE ZONE LIVESTOCK FEED RATIONS

```
PRFFEED) - 200.1427 PS1RIB - 314.091 PS1RIO - 256.2396 PS1COG
    - 33.63709 PS1CO3 - 37.0008 PS1CO4 - 384.7378 PS1SUG - 108.9185 PS1PUK
    - 878.8129 PS1VEK - 439.139 PS1WHE - 417.182 PS1WHL - 227.1477 PS1BAR
    - 116.7775 PS1PUR - 269.8495 PS1HVA - 210.5972 PM1RIB - 330.434 PM1RIO
    - 289.4817 PM1COG - 33.30892 PM1CO3 - 36.63981 PM1CO4
```

```
    - 398.7768 PM1SUG - 83.78347 PM1PUK - 810.4023 PM1VEK - 443.986 PM1WHE
    - 421.7867 PM1WHL - 229.6549 PM1BAR - 118.0665 PM1PUR
    - 248.8433 PM1HVA - 209.5337 PL1RIB - 328.7877 PL1RIO
    - 266.4891 PL1COG - 35.93425 PL1CO3 - 39.52768 PL1CO4 - 387.58 PL1SUG
    - 133.1226 PL1PUK - 652.5317 PL1VEK - 461.4353 PL1WHE
    - 438.3635 PL1WHL - 238.6806 PL1BAR - 122.7066 PL1PUR
    - 200.3673 PL1HVA + 275.8823 L1MCA1 + 303.5 L1MCA2 + 275.9 L1MCA3
    + 20.89 L1NMC1 + 22.99 L1NMC2 + 20.89 L1NMC3 + 24.48 L1GOS1
    + 26.93 L1GOS2 + 25.71 L1GOS3 + 12.62357 L1BRO1 + 15.77946 L1BRO2
    + 15.14828 L1BRO3 + 13.17242 L1BRO4 + 12.62357 L1LAY1
    + 15.77946 L1LAY2 + 15.14828 L1LAY3 + 10.97702 L1LAY4 + 4.93537 L1DESI
    <=   0

PRFCAKE)   102.6285 L1MCA1 + 102.6 L1MCA2 + 112.86 L1MCA3 + 3.6732 L1NMC1
    + 3.6732 L1NMC2 + 4.0404 L1NMC3 + 0.3243 L1BRO1 + 0.40538 L1BRO2
    + 0.38916 L1BRO3 + 0.3384 L1BRO4 + 0.3243 L1LAY1 + 0.40538 L1LAY2
    + 0.38916 L1LAY3 + 0.282 L1LAY4 - DF1CAK <=   0

PRFSTRAW) - 2544.34 PS1RIB - 2661.71 PS1RIO - 960.8984 PS1COG
    - 3847.378 PS1SUG - 414.7398 PS1TOK - 1372.316 PS1NOK
    - 453.8272 PS1PUK - 1757.626 PS1VEK - 2335.846 PS1WHE
    - 2219.054 PS1WHL - 946.4487 PS1BAR - 493.1484 PS1PUR
    - 1117.435 PS1TOR - 1345.28 PS1NOR - 2676.858 PM1RIB - 2800.341 PM1RIO
    - 1008.943 PM1COG - 3987.768 PM1SUG - 319.0306 PM1TOK
    - 1055.628 PM1NOK - 349.0978 PM1PUK - 1620.805 PM1VEK
    - 2361.628 PM1WHE - 2243.547 PM1WHL - 956.8952 PM1BAR
    - 498.5915 PM1PUR - 859.5656 PM1TOR - 1034.831 PM1NOR
    - 2663.606 PL1RIB - 2786.477 PL1RIO - 999.3343 PL1COG - 3875.8 PL1SUG
    - 506.9042 PL1TOK - 1677.276 PL1NOK - 554.6776 PL1PUK
    - 1305.064 PL1VEK - 2454.443 PL1WHE - 2331.721 PL1WHL
    - 994.5025 PL1BAR - 518.1868 PL1PUR - 1365.754 PL1TOR
    - 1644.232 PL1NOR + 819.0556 L1MCA1 + 900.8 L1MCA2 + 819.2 L1MCA3
    + 819.2 L1NMC1 + 900.8 L1NMC2 + 819.2 L1NMC3 + 469.52 L1GOS1
    + 516.48 L1GOS2 + 493.04 L1GOS3 <=   0

PRFGREK) - 33.92453 PS1RIB - 53.23419 PS1RIO - 12.81197 PS1COG
    - 10.34987 PS1CO3 - 11.38486 PS1CO4 - 12696.35 PS1SUG
    - 41.47398 PS1TOK - 274.4633 PS1NOK - 45.38271 PS1PUK
    - 1757.626 PS1VEK - 11277.23 PS1FDK - 370.1846 PS1FRU
    - 35.69143 PM1RIB - 56.0068 PM1RIO - 13.45257 PM1COG - 10.2489 PM1CO3
    - 11.27379 PM1CO4 - 13159.64 PM1SUG - 31.90306 PM1TOK
    - 211.1256 PM1NOK - 34.90978 PM1PUK - 1620.805 PM1VEK
    - 10713.37 PM1FDK - 366.5731 PM1FRU - 35.51474 PL1RIB
    - 55.72954 PL1RIO - 13.32445 PL1COG - 11.05669 PL1CO3
    - 12.16236 PL1CO4 - 12790.14 PL1SUG - 50.69042 PL1TOK
    - 335.4551 PL1NOK - 55.46776 PL1PUK - 1305.064 PL1VEK
    - 10149.51 PL1FDK - 395.4656 PL1FRU + 555.874 L1MCA1 + 555.874 L1MCA2
    + 555.84 L1MCA3 + 555.874 L1NMC1 + 555.84 L1NMC2 + 555.874 L1NMC3
    + 318.6593 L1GOS1 + 318.64 L1GOS2 + 318.6593 L1GOS3 <=   0

PRFGRER) - 93.43383 PS1WHE - 88.76213 PS1WHL - 37.85795 PS1BAR
    - 19.72593 PS1PUR - 539.699 PS1HVA - 223.4871 PS1TOR - 269.056 PS1NOR
    - 27872.99 PS1FDR - 370.1846 PS1FRU - 94.4651 PM1WHE - 89.74185 PM1WHL
    - 38.2758 PM1BAR - 19.94365 PM1PUR - 497.6865 PM1HVA - 171.9131 PM1TOR
    - 206.9662 PM1NOR - 26479.34 PM1FDR - 366.5731 PM1FRU
    - 98.17771 PL1WHE - 93.26882 PL1WHL - 39.78009 PL1BAR
    - 20.72747 PL1PUR - 400.7346 PL1HVA - 273.1508 PL1TOR
    - 328.8463 PL1NOR - 25085.69 PL1FDR - 395.4656 PL1FRU
    + 1670.365 L1MCA1 + 1670.365 L1MCA2 + 1670 L1MCA3 + 1670.365 L1NMC1
    + 1670 L1NMC2 + 1670.365 L1NMC3 + 957.5497 L1GOS1 + 957.5 L1GOS2
    + 957.5497 L1GOS3 <=   0
```

```
 PRFPAST)   3.609 L1MCA1 + 3.609 L1MCA2 + 3.609 LIMCA3 + 3.609 L1NMC1
     + 3.609 L1NMC2 + 3.609 L1NMC3 + 7.433 L1GOS1 + 7.433 L1GOS2
     + 7.433 L1GOS3 <=   19525

PRFFISHM)   1.844 L1BRO1 + 2.305 L1BRO2 + 1.844 L1BRO3 + 1.924 L1BRO4
     + 1.844 L1LAY1 + 2.306 L1LAY2 + 1.844 L1LAY3 + 1.604 L1LAY4
     <=   24900
```

PUNJAB RICE ZONE HERD LEVELS

```
 PRHLMCA)   L1MCA1 + L1MCA2 + LIMCA3 =    2098.008

PRHLNMCA)   L1NMC1 + L1NMC2 + L1NMC3 =    2769.998

PRHLGOSH)   L1GOS1 + L1GOS2 + L1GOS3 =    263

 PRHLBRO)   L1BRO1 + L1BRO2 + L1BRO3 + L1BRO4 =    9860.015

 PRHLLAY)   L1LAY1 + L1LAY2 + L1LAY3 + L1LAY4 =    3290.001

PRHLDESI)   L1DESI =    8510.007
```

PUNJAB SUGARCANE ZONE
SMALL FARM RESOURCE RESTRICTIONS

```
PSSRFALK)   438.0342 PS2RIB + 295.9896 PS2RIO + 326.7898 PS2COG
     + 848.6032 PS2CO3 + 933.4635 PS2CO4 + 1311.088 PS2SUG
     + 797.6753 PS2TOK + 357.8616 PS2NOK + 205.655 PS2PUK + 257.7376 PS2VEK
     + 1678.204 PS2FDK + 313.4 PS2FRU <=   1249338


 PSSRLAK)   PS2RIB + PS2RIO + PS2COG + PS2CO3 + PS2CO4 + PS2SUG + PS2TOK
     + PS2NOK + PS2PUK + PS2VEK + PS2FDK + PS2FRU <=   367

PSSRFALR)   234.1347 PS2WHE + 257.5481 PS2WHL + 187.3328 PS2BAR
     + 121.8203 PS2PUR + 482.3392 PS2HVA + 131.9514 PS2TOR
     + 357.8616 PS2NOR + 1678.204 PS2FDR + 313.41 PS2FRU <=   1249338

 PSSRLAR)   PS2SUG + PS2WHE + PS2WHL + PS2BAR + PS2PUR + PS2HVA + PS2TOR
     + PS2NOR + PS2FDR + PS2FRU <=   509

PSSROBCW)   PS2RIB + PS2CO4 + PS2WHE <=   509

PSSMKTSW)   1952.154 PS2WHE + 1854.546 PS2WHL + HS2WHE >=   404252

PSSMKTSR)   1653.457 PS2RIB + 2776.107 PS2RIO + HS2RIC >=   28364
```

PUNJAB SUGARCANE ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

```
PSMRFALK)   426.5935 PM2RIB + 184.5656 PM2RIO + 326.7651 PM2COG
     + 476.415 PM2CO3 + 524.0565 PM2CO4 + 1064.655 PM2SUG + 530.8911 PM2TOK
     + 255.0376 PM2NOK + 156.8139 PM2PUK + 166.428 PM2VEK + 1474.989 PM2FDK
     + 239.49 PM2FRU <=   430241

 PSMRLAK)   PM2RIB + PM2RIO + PM2COG + PM2CO3 + PM2CO4 + PM2SUG + PM2TOK
     + PM2NOK + PM2PUK + PM2VEK + PM2FDK + PM2FRU <=   231

PSMRFALR)   166.2699 PM2WHE + 182.8969 PM2WHL + 176.4559 PM2BAR
     + 84.7553 PM2PUR + 294.5432 PM2HVA + 72.1532 PM2TOR + 255.0376 PM2NOR
     + 1474.989 PM2FDR + 239.49 PM2FRU <=   430241
```

```
 PSMRLAR)   PM2SUG + PM2WHE + PM2WHL + PM2BAR + PM2PUR + PM2HVA + PM2TOR
     + PM2NOR + PM2FDR + PM2FRU <=   429

PSMROBCW)   PM2RIB + PM2CO4 + PM2WHE <=   429

PSMMKTSW)   1973.701 PM2WHE + 1875.016 PM2WHL + HM2WHE >=   139214

PSMMKTSR)   1739.575 PM2RIB + 2920.696 PM2RIO + HM2RIC >=   9768
```

PUNJAB SUGARCANE ZONE
LARGE FARM RESOURCE RESTRICTIONS

```
PSLRFALK)   338.4529 PL2RIB + 85.0024 PL2RIO + 202.2019 PL2COG
     + 301.483 PL2CO3 + 331.6313 PL2CO4 + 911.5519 PL2SUG + 158.4641 PL2TOK
     + 143.318 PL2NOK + 98.08881 PL2PUK + 68.1996 PL2VEK + 1101.671 PL2FDK
     + 50 PL2FRU <=   228785

 PSLRLAK)   PL2RIB + PL2RIO + PL2COG + PL2CO3 + PL2CO4 + PL2SUG + PL2TOK
     + PL2NOK + PL2PUK + PL2VEK + PL2FDK + PL2FRU <=   209

PSLRFALR)   128.2647 PL2WHE + 141.0911 PL2WHL + 157.6674 PL2BAR
     + 58.0685 PL2PUR + 119.5964 PL2HVA + 33.1114 PL2TOR + 143.318 PL2NOR
     + 1101.671 PL2FDR + 50 PL2FRU <=   228785

 PSLRLAR)   PL2SUG + PL2WHE + PL2WHL + PL2BAR + PL2PUR + PL2HVA + PL2TOR
     + PL2NOR + PL2FDR + PL2FRU <=   355

PSLROBCW)   PL2RIB + PL2CO4 + PL2WHE <=   355

PSLMKTSW)   2051.27 PL2WHE + 1948.706 PL2WHL + HL2WHE >=   74029

PSLMKTSR)   1730.963 PL2RIB + 2906.237 PL2RIO + HL2RIC >=   5194
```

PUNJAB SUGARCANE ZONE
ZONAL RESOURCE RESTRICTIONS

```
 PSRFENK)   35.27837 PS2RIB + 38.39158 PS2RIO + 44.67384 PS2COG
     + 57.69208 PS2CO3 + 63.46129 PS2CO4 + 44.67384 PS2SUG + 6.28225 PS2TOK
     + 48.86201 PS2NOK + 173.1112 PS2VEK + 32.10932 PS2FDK + 55.9744 PS2FRU
     + 54.9209 PM2RIB + 38.39158 PM2RIO + 56.28904 PM2COG + 85.92804 PM2CO3
     + 94.52085 PM2CO4 + 97.23541 PM2SUG + 6.28225 PM2TOK + 48.86201 PM2NOK
     + 173.1112 PM2VEK + 32.10932 PM2FDK + 55.9744 PM2FRU + 76.30851 PL2RIB
     + 38.39158 PL2RIO + 60.7285 PL2COG + 100.6097 PL2CO3 + 110.6707 PL2CO4
     + 101.1304 PL2SUG + 6.28225 PL2TOK + 48.86201 PL2NOK + 173.1112 PL2VEK
     + 32.10932 PL2FDK + 55.9744 PL2FRU - A2FENK <=   0

 PSRFEPK)   1.47363 PS2RIB + 6.77871 PS2RIO + 13.55743 PS2COG
     + 19.31933 PS2CO3 + 21.25127 PS2CO4 + 13.55743 PS2SUG + 6.77871 PS2TOK
     + 14.73633 PS2NOK + 27.11486 PS2VEK + 5.89453 PS2FDK + 23.02325 PS2FRU
     + 13.55743 PM2RIB + 6.77871 PM2RIO + 13.96415 PM2COG + 23.95598 PM2CO3
     + 26.35157 PM2CO4 + 28.74175 PM2SUG + 6.77871 PM2TOK + 14.73633 PM2N K
     + 27.11486 PM2VEK + 5.89453 PM2FDK + 23.02325 PM2FRU + 10.91667 PL2RIB
     + 6.77871 PL2RIO + 13.55743 PL2COG + 24.08477 PL2CO3 + 26.49325 PL2CO4
     + 29.28405 PL2SUG + 6.77871 PL2TOK + 14.73633 PL2NOK + 27.11486 PL2VEK
     + 5.89453 PL2FDK + 23.02325 PL2FRU - A2FEPK <=   0

 PSRFEKK)   6.22951 PS2RIO + 12.45903 PS2TOK + 12.45903 PS2VEK
     + 1.99344 PS2FDK + 6.67804 PM2RIB + 6.22951 PM2RIO + 24.91807 PM2SUG
     + 12.45903 PM2TOK + 12.45903 PM2VEK + 1.99344 PM2FDK + 6.22951 PL2RIO
     + 12.45903 PL2TOK + 1.99344 PL2FDK - A2FEKK <=   0
```

```
PLSFENK)   A2FENK <=   46632

PLSFEPK)   A2FEPK <=   12105

PLSFEKK)   A2FEKK <=   2017

PSRBULK)   188.7597 PS2RIB + 35.052 PS2RIO + 65.9757 PS2COG
    + 53.99135 PS2CO3 + 59.39048 PS2CO4 + 77.16933 PS2SUG + 5.35465 PS2TOK
    + 37.62 PS2NOK + 48.10402 PS2PUK + 26.452 PS2VEK + 5.93 PS2FDK
    + 57.325 PS2FRU + 161.6528 PM2RIB + 17.526 PM2RIO + 38.74528 PM2COG
    + 35.02395 PM2CO3 + 38.52634 PM2CO4 + 51.49564 PM2SUG + 2.67732 PM2TOK
    + 28.694 PM2NOK + 43.82001 PM2PUK + 13.226 PM2VEK + 2.965 PM2FDK
    + 28.665 PM2FRU + 96.8632 PL2RIB + 19.768 PL2NOK + 39.536 PL2PUK
    <=   261350

PSRFENR)   35.79282 PS2WHE + 39.04211 PS2WHL + 11.11599 PS2BAR
    + 5.00219 PS2PUR + 96.70918 PS2HVA + 35.57119 PS2TOR + 38.90599 PS2NOR
    + 25.56679 PS2FDR + 79.729 PS2FRU + 75.57406 PM2WHE + 83.13146 PM2WHL
    + 13.33919 PM2BAR + 5.00219 PM2PUR + 96.70918 PM2HVA + 35.57119 PM2TOR
    + 38.90599 PM2NOR + 25.56679 PM2FDR + 79.729 PM2FRU + 67.88095 PL2WHE
    + 74.66905 PL2WHL + 14.45079 PL2BAR + 5.00219 PL2PUR + 96.70918 PL2HVA
    + 35.57119 PL2TOR + 38.90599 PL2NOR + 25.56679 PL2FDR + 79.729 PL2FRU
    - A2FENR <=   0

PSRFEPR)   14.47939 PS2WHE + 15.92733 PS2WHL + 7.62073 PS2PUR
    + 30.48294 PS2HVA + 15.24147 PS2TOR + 16.56681 PS2NOR + 6.62672 PS2FDR
    + 91.06086 PS2FRU + 32.07186 PM2WHE + 35.27905 PM2WHL + 7.62073 PM2PUR
    + 30.48294 PM2HVA + 15.24147 PM2TOR + 16.56681 PM2NOR + 6.62672 PM2FDR
    + 91.06086 PM2FRU + 27.36606 PL2WHE + 30.10267 PL2WHL + 7.62073 PL2PUR
    + 30.48294 PL2HVA + 15.24147 PL2TOR + 16.56681 PL2NOR + 6.62672 PL2FDR
    + 91.06086 PL2FRU - A2FEPR <=   0

PSRFEKR)   6.39992 PS2HVA + 0.25599 PS2FDR + 3.03996 PM2WHE
    + 3.34396 PM2WHL + 6.39992 PM2HVA + 0.25599 PM2FDR + 6.07992 PL2WHE
    + 6.68791 PL2WHL + 6.39992 PL2HVA + 0.25599 PL2FDR - A2FEKR <=   0

PLSFENR)   A2FENR <=   60268

PLSFEPR)   A2FEPR <=   25853

PLSFEKR)   A2FEKR <=   1874

PSRBULR)   65.61493 PS2WHE + 62.33418 PS2WHL + 149.7558 PS2BAR
    + 58.5627 PS2PUR + 29.652 PS2HVA + 21.2506 PS2TOR + 37.62 PS2NOR
    + 5.93 PS2FDR + 57.325 PS2FRU + 46.2077 PM2WHE + 43.89731 PM2WHL
    + 149.7558 PM2BAR + 49.6671 PM2PUR + 14.826 PM2HVA + 11.8608 PM2TOR
    + 28.694 PM2NOR + 2.965 PM2FDR + 28.665 PM2FRU + 149.7558 PL2BAR
    + 40.7715 PL2PUR + 2.471 PL2TOR + 19.768 PL2NOR + 28.665 PL2FRU
    <=   261350

 PSRFYM)   6.62228 PS2RIB + 1.2355 PS2RIO + 17.91475 PS2COG
    + 18.7796 PS2CO3 + 20.65756 PS2CO4 + 19.96568 PS2SUG + 37.065 PS2FDK
    + 21.7448 PS2WHE + 20.65756 PS2WHL + 148.26 PS2HVA + 37.065 PS2FDR
    + 37.07 PS2FRU + 7.83307 PM2RIB + 1.2355 PM2RIO + 28.58947 PM2COG
    + 26.03322 PM2CO3 + 28.63654 PM2CO4 + 28.1694 PM2SUG + 37.065 PM2FDK
    + 20.38575 PM2WHE + 19.36646 PM2WHL + 148.26 PM2HVA + 37.065 PM2FDR
    + 37.07 PM2FRU + 6.52344 PL2RIB + 1.2355 PL2RIO + 29.652 PL2COG
    + 25.82195 PL2CO3 + 28.40414 PL2CO4 + 27.99643 PL2SUG + 2.471 PL2VEK
    + 37.065 PL2FDK + 48.9258 PL2WHE + 46.47951 PL2WHL + 148.26 PL2HVA
    + 37.065 PL2FDR + 37.07 PL2FRU <=   50000
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289

```
PSRTOWK)   8.74734 PS2RIB + 8.327269 PS2RIO + 3.4594 PS2COG
    + 4.57752 PS2CO3 + 5.03528 PS2CO4 + 4.028 PS2SUG + 1.60615 PS2TOK
    + 3.77445 PS2NOK + 1.60615 PS2PUK + 8.85606 PS2VEK + 4.57135 PS2FDK
    + 4.905 PS2FRU + 8.74734 PM2RIB + 8.327269 PM2RIO + 3.4594 PM2COG
    + 4.57752 PM2CO3 + 5.03528 PM2CO4 + 4.028 PM2SUG + 1.60615 PM2TOK
    + 3.77445 PM2NOK + 1.60615 PM2PUK + 8.85606 PM2VEK + 4.57135 PM2FDK
    + 4.905 PM2FRU + 8.74734 PL2RIB + 8.327269 PL2RIO + 3.4594 PL2COG
    + 4.57752 PL2CO3 + 5.03528 PL2CO4 + 4.028 PL2SUG + 1.60615 PL2TOK
    + 3.77445 PL2NOK + 1.60615 PL2PUK + 8.85606 PL2VEK + 4.57135 PL2FDK
    + 4.905 PL2FRU - IB2CAK - IB2TUK <=   0

PSRTOWR)   4.027 PS2SUG + 3.92889 PS2WHE + 2.52042 PS2WHL + 3.4594 PS2BAR
    + 1.60615 PS2PUR + 3.7065 PS2HVA + 2.9652 PS2TOR + 3.77445 PS2NOR
    + 6.1775 PS2FDR + 4.905 PS2FRU + 4.027 PM2SUG + 3.92889 PM2WHE
    + 2.64397 PM2WHL + 3.4594 PM2BAR + 1.60615 PM2PUR + 3.7065 PM2HVA
    + 2.9652 PM2TOR + 3.77445 PM2NOR + 6.1775 PM2FDR + 4.905 PM2FRU
    + 4.027 PL2SUG + 3.92889 PL2WHE + 2.64397 PL2WHL + 3.4594 PL2BAR
    + 1.60615 PL2PUR + 3.7065 PL2HVA + 2.9652 PL2TOR + 3.77445 PL2NOR
    + 6.1775 PL2FDR + 4.905 PL2FRU - IB2CAR - IB2TUR <=   0

PSRCAWK)   IB2CAK <=   5129

PSRCAWR)   IB2CAR <=   2415

PSRTUWK)   IB2TUK <=   900

PSRTUWR)   IB2TUR <=   900
```

PUNJAB SUGARCANE ZONE LIVESTOCK FEED RATIONS

```
PSFFEED) - 195.1057 PS2RIB - 327.5707 PS2RIO - 472.6374 PS2COG
    - 58.33406 PS2CO3 - 64.16747 PS2CO4 - 391.0733 PS2SUG
    - 118.5139 PS2PUK - 893.7293 PS2VEK - 458.7561 PS2WHE
    - 435.8183 PS2WHL - 235.0966 PS2BAR - 103.5726 PS2PUR
    - 364.7594 PS2HVA - 205.2775 PM2RIB - 344.6496 PM2RIO
    - 496.2693 PM2COG - 57.76495 PM2CO3 - 63.54145 PM2CO4
    - 405.3435 PM2SUG - 118.5139 PM2PUK - 824.1576 PM2VEK
    - 463.8197 PM2WHE - 440.6287 PM2WHL - 237.6915 PM2BAR
    - 104.7158 PM2PUR - 336.365 PM2HVA - 204.2563 PL2RIB - 342.9237 PL2RIO
    - 491.5429 PL2COG - 62.31785 PL2CO3 - 68.54964 PL2CO4
    - 393.9624 PL2SUG - 144.8503 PL2PUK - 663.6074 PL2VEK
    - 482.0483 PL2WHE - 457.946 PL2WHL - 247.0331 PL2BAR - 108.8313 PL2PUR
    - 270.8393 PL2HVA + 298.9 L2MCA1 + 328.8 L2MCA2 + 298.9 L2MCA3
    + 20.65 L2NMC1 + 22.72 L2NMC2 + 20.65 L2NMC3 + 10.89 L2GOS1
    + 11.98 L2GOS2 + 11.44 L2GOS3 + 12.66912 L2BRO1 + 15.8364 L2BRO2
    + 15.20295 L2BRO3 + 13.21995 L2BRO4 + 12.66912 L2LAY1 + 15.8364 L2LAY2
    + 15.20295 L2LAY3 + 11.01663 L2LAY4 + 4.94296 L2DESI <=   0

PSFCAKE)   136.8 L2MCA1 + 136.8 L2MCA2 + 150.56 L2MCA3 + 4.8784 L2NMC1
    + 4.8784 L2NMC2 + 5.3664 L2NMC3 + 0.43072 L2BRO1 + 0.53841 L2BRO2
    + 0.51687 L2BRO3 + 0.44945 L2BRO4 + 0.43072 L2LAY1 + 0.53841 L2LAY2
    + 0.51687 L2LAY3 + 0.37454 L2LAY4 - DF2CAK <=   0

PSFSTRAW) - 2480.186 PS2RIB - 2776.107 PS2RIO - 1772.39 PS2COG
    - 3910.733 PS2SUG - 885.2032 PS2TOK - 1563.254 PS2NOK
    - 493.8078 PS2PUK - 1787.459 PS2VEK - 2440.192 PS2WHE
    - 2318.183 PS2WHL - 979.5691 PS2BAR - 437.3845 PS2PUR
    - 1037.036 PS2TOR - 1348.487 PS2NOR - 2609.362 PM2RIB
    - 2920.696 PM2RIO - 1861.01 PM2COG - 4053.435 PM2SUG - 680.9255 PM2TOK
    - 1202.503 PM2NOK - 555.5 PM2PUK - 1648.315 PM2VEK - 2467.126 PM2WHE
    - 2343.77 PM2WHL - 990.3811 PM2BAR - 442.2121 PM2PUR - 1037.298 PM2NOR
    - 2596.445 PL2RIB - 2906.237 PL2RIO - 1843.286 PL2COG
```

```
     - 3939.624 PL2SUG - 603.5429 PL2PUK - 1327.215 PL2VEK
     - 2564.087 PL2WHE - 2435.883 PL2WHL - 1029.305 PL2BAR
     - 459.5917 PL2PUR - 1267.489 PL2TOR - 1648.15 PL2NOR + 678.96 L2MCA1
     + 746.88 L2MCA2 + 678.96 L2MCA3 + 678.96 L2NMC1 + 746.88 L2NMC2
     + 678.96 L2NMC3 + 168.48 L2GOS1 + 185.36 L2GOS2 + 176.96 L2GOS3
     <=   0

PSFGREK) - 33.06914 PS2RIB - 55.52214 PS2RIO - 23.63187 PS2COG
     - 17.94894 PS2CO3 - 19.74383 PS2CO4 - 12905.42 PS2SUG
     - 88.52031 PS2TOK - 312.6509 PS2NOK - 49.38077 PS2PUK
     - 1787.459 PS2VEK - 13068.27 PS2FDK - 436.7324 PS2FRU
     - 34.79149 PM2RIB - 58.41392 PM2RIO - 24.81346 PM2COG
     - 17.77383 PM2CO3 - 19.55121 PM2CO4 - 13376.34 PM2SUG
     - 68.09255 PM2TOK - 240.5007 PM2NOK - 55.6 PM2PUK - 1648.315 PM2VEK
     - 12414.86 PM2FDK - 432.4716 PM2FRU - 34.61925 PL2RIB
     - 58.12474 PL2RIO - 24.57714 PL2COG - 19.17472 PL2CO3
     - 21.09219 PL2CO4 - 13000.76 PL2SUG - 60.35428 PL2PUK
     - 1327.215 PL2VEK - 11761.44 PL2FDK - 466.5581 PL2FRU
     + 1138.757 L2MCA1 + 1138.4 L2MCA2 + 1138.757 L2MCA3 + 1138.757 L2NMC1
     + 1138.4 L2NMC2 + 1138.757 L2NMC3 + 282.6295 L2GOS1 + 282.64 L2GOS2
     + 282.6295 L2GOS3 <=   0

 PSFGRER) - 97.60768 PS2WHE - 92.72729 PS2WHL - 39.18276 PS2BAR
     - 17.49537 PS2PUR - 729.5189 PS2HVA - 207.4072 PS2TOR
     - 269.6973 PS2NOR - 31985.48 PS2FDR - 436.7324 PS2FRU
     - 98.68503 PM2WHE - 93.75077 PM2WHL - 39.61524 PM2BAR
     - 17.68848 PM2PUR - 672.7299 PM2HVA - 207.4595 PM2NOR
     - 30386.21 PM2FDR - 432.4716 PM2FRU - 102.5635 PL2WHE - 97.4353 PL2WHL
     - 41.17217 PL2BAR - 18.38366 PL2PUR - 541.6787 PL2HVA
     - 253.4977 PL2TOR - 329.63 PL2NOR - 28786.93 PL2FDR - 466.5581 PL2FRU
     + 1887.266 L2MCA1 + 1887 L2MCA2 + 1887.266 L2MCA3 + 1887.266 L2NMC1
     + 1887 L2NMC2 + 1887.266 L2NMC3 + 468.4028 L2GOS1 + 468.4 L2GOS2
     + 468.4028 L2GOS3 <=   0

 PSFPAST)   5.069 L2MCA1 + 5.069 L2MCA2 + 5.069 L2MCA3 + 5.069 L2NMC1
     + 5.069 L2NMC2 + 5.069 L2NMC3 + 4.52 L2GOS1 + 4.52 L2GOS2
     + 4.52 L2GOS3 <=   17125
PSFFISHM)   1.907 L2BRO1 + 2.383 L2BRO2 + 1.907 L2BRO3 + 1.989 L2BRO4
     + 1.907 L2LAY1 + 2.383 L2LAY2 + 1.907 L2LAY3 + 1.658 L2LAY4
     <=   15450
```

PUNJAB SUGARCANE ZONE HERD LEVELS

```
 PSHLMCA)   L2MCA1 + L2MCA2 + L2MCA3 =    1242

PSHLNMCA)   L2NMC1 + L2NMC2 + L2NMC3 =    1798.004

PSHLGOSH)   L2GOS1 + L2GOS2 + L2GOS3 =    378.999

 PSHLBRO)   L2BRO1 + L2BRO2 + L2BRO3 + L2BRO4 =    6100.003

 PSHLLAY)   L2LAY1 + L2LAY2 + L2LAY3 + L2LAY4 =    2030.002

PSHLDESI)   L2DESI =    5259.995
```

PUNJAB COTTON ZONE
SMALL FARM RESOURCE RESTRICTIONS

```
PCSRFALK)   384.4135 PS3RIB + 295.9896 PS3RIO + 305.1685 PS3COG
     + 403.8318 PS3CO3 + 444.215 PS3CO4 + 1076.121 PS3SUG + 797.6753 PS3TOK
     + 357.8616 PS3NOK + 205.655 PS3PUK + 257.7376 PS3VEK + 1678.204 PS3FDK
     + 313.405 PS3FRU <=   4356284
```


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PCSRLAK) PS3RIB + PS3RIO + PS3COG + PS3CO3 + PS3CO4 + PS3SUG + PS3TOK
+ PS3NOK + PS3PUK + PS3VEK + PS3FDK + PS3FRU <= 1214

PCSRFALR) 184.6504 PS3WHE + 203.1155 PS3WHB + 187.3328 PS3BAR
+ 121.8203 PS3PUR + 231.0879 PS3HVA + 131.9514 PS3TOR
+ 357.8616 PS3NOR + 1678.204 PS3FDR + 313.405 PS3FRU <= 4356284

PCSRLAR) PS3SUG + PS3WHE + PS3WHB + PS3BAR + PS3PUR + PS3HVA + PS3TOR
+ PS3NOR + PS3FDR + PS3FRU <= 1529

PCSROBCW) PS3RIB + PS3CO4 + PS3WHE <= 1529

PCSMKTSW) 1987.406 PS3WHE + 1888.036 PS3WHB + HS3WHE >= 1409580

PCSMKTSR) 1866.451 PS3RIB + 2158.782 PS3RIO + HS3RIC >= 98901

PUNJAB COTTON ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

PCMRFALK) 262.272 PM3RIB + 202.622 PM3RIO + 35.5824 PM3COG
+ 192.0214 PM3CO3 + 211.2236 PM3CO4 + 1012.838 PM3SUG
+ 530.8911 PM3TOK + 255.0376 PM3NOK + 156.8139 PM3PUK + 166.428 PM3VEK
+ 1474.989 PM3FDK + 239.47 PM3FRU <= 1829499

PCMRLAK) PM3RIB + PM3RIO + PM3COG + PM3CO3 + PM3CO4 + PM3SUG + PM3TOK
+ PM3NOK + PM3PUK + PM3VEK + PM3FDK + PM3FRU <= 1022

PCMRFALR) 137.7014 PM3WHE + 151.4716 PM3WHB + 176.4559 PM3BAR
+ 84.7553 PM3PUR + 137.3876 PM3HVA + 72.1532 PM3TOR + 255.0376 PM3NOR
+ 1474.989 PM3FDR + 239.47 PM3FRU <= 1829499

PCMRLAR) PM3SUG + PM3WHE + PM3WHB + PM3BAR + PM3PUR + PM3HVA + PM3TOR
+ PM3NOR + PM3FDR + PM3FRU <= 1315

PCMROBCW) PM3RIB + PM3CO4 + PM3WHE <= 1315

PCMMKTSW) 2009.342 PM3WHE + 1908.875 PM3WHB + HM3WHE >= 591976

PCMMKTSR) 1963.662 PM3RIB + 2271.218 PM3RIO + HM3RIC >= 41535

PCLRFALK) 208.6513 PL3RIB + 85.0024 PL3RIO + 171.2897 PL3COG
+ 209.9325 PL3CO3 + 230.9257 PL3CO4 + 554.27 PL3SUG + 158.4641 PL3TOK
+ 143.318 PL3NOK + 98.08881 PL3PUK + 68.1996 PL3VEK + 1101.671 PL3FDK
+ 50 PL3FRU <= 1239187

PCLRLAK) PL3RIB + PL3RIO + PL3COG + PL3CO3 + PL3CO4 + PL3SUG + PL3TOK
+ PL3NOK + PL3PUK + PL3VEK + PL3FDK + PL3FRU <= 1439

PCLRFALR) 89.53174 PL3WHE + 98.48491 PL3WHB + 157.6674 PL3BAR
+ 58.0685 PL3PUR + 149.4461 PL3HVA + 33.1114 PL3TOR + 143.318 PL3NOR
+ 1101.671 PL3FDR + 50 PL3FRU <= 1239187

PCLRLAR) PL3SUG + PL3WHE + PL3WHB + PL3BAR + PL3PUR + PL3HVA + PL3TOR
+ PL3NOR + PL3FDR + PL3FRU <= 1797

PCLROBCW) PL3RIB + PL3CO4 + PL3WHE <= 1797

PCLMKTSW) 2088.312 PL3WHE + 1983.896 PL3WHB + HL3WHE >= 400967

PCLMKTSR) 1953.941 PL3RIB + 2259.975 PL3RIO + HL3RIC >= 28133

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PUNJAB COTTON ZONE
ZONAL RESOURCE RESTRICTIONS

```
PCRFENK)   33.02049 PS3RIB + 33.20673 PS3RIO + 55.53888 PS3COG
    + 74.42972 PS3CO3 + 81.86297 PS3CO4 + 87.20711 PS3SUG + 5.43324 PS3TOK
    + 42.84243 PS3NOK + 149.7178 PS3VEK + 27.77349 PS3FDK + 61.6361 PS3FRU
    + 42.95579 PM3RIB + 99.5959 PM3COG + 89.15048 PM3CO3 + 98.1384 PM3CO4
    + 124.4544 PM3SUG + 5.43324 PM3TOK + 42.25943 PM3NOK + 149.7178 PM3VEK
    + 27.77349 PM3FDK + 61.6361 PM3FRU + 36.28367 PL3RIB + 33.20673 PL3RIO
    + 38.63997 PL3COG + 103.4016 PL3CO3 + 113.7661 PL3CO4
    + 177.4912 PL3SUG + 5.43324 PL3TOK + 42.25943 PL3NOK + 149.7178 PL3VEK
    + 27.77349 PL3FDK + 61.6361 PL3FRU - A3FENK <=   0

PCRFEPK)   3.5684 PS3RIB + 5.37833 PS3RIO + 10.75666 PS3COG
    + 20.43765 PS3CO3 + 22.48142 PS3CO4 + 21.51332 PS3SUG + 5.37833 PS3TOK
    + 11.69202 PS3NOK + 21.51332 PS3VEK + 4.6768 PS3FDK + 23.39382 PS3FRU
    + 8.40422 PM3RIB + 16.13499 PM3COG + 18.90483 PM3CO3 + 20.79531 PM3CO4
    + 25.06302 PM3SUG + 5.37833 PM3TOK + 11.69202 PM3NOK + 21.51332 PM3VEK
    + 4.6768 PM3FDK + 23.39382 PM3FRU + 6.79072 PL3RIB + 5.37833 PL3RIO
    + 10.75666 PL3COG + 21.35735 PL3CO3 + 23.49308 PL3CO4
    + 10.75666 PL3SUG + 5.37833 PL3TOK + 11.69202 PL3NOK + 21.51332 PL3VEK
    + 4.6768 PL3FDK + 23.39382 PL3FRU - A3FEPK <=   0

PCRFEKK)   16.85749 PS3RIO + 33.71499 PS3TOK + 33.71499 PS3VEK
    + 5.39439 PS3FDK + 67.42998 PM3RIB + 33.71499 PM3TOK + 33.71499 PM3VEK
    + 5.39439 PM3FDK + 16.85749 PL3RIO + 33.71499 PL3TOK + 5.39439 PL3FDK
    - A3FEKK <=   0

PLCFENK)   A3FENK <=   274292

PLCFEPK)   A3FEPK <=   58574

PLCFEKK)   A3FEKK <=   8501

PCRBULK)   143.4168 PS3RIB + 35.052 PS3RIO + 49.42 PS3COG + 73.35781 PS3CO3
    + 80.69359 PS3CO4 + 7.413 PS3SUG + 5.35465 PS3TOK + 37.62 PS3NOK
    + 48.10402 PS3PUK + 26.452 PS3VEK + 5.93 PS3FDK + 57.325 PS3FRU
    + 110.5526 PM3RIB + 4.942 PM3RIO + 8.52495 PM3COG + 30.93939 PM3CO3
    + 34.03333 PM3CO4 + 8.6485 PM3SUG + 2.67732 PM3TOK + 28.694 PM3NOK
    + 43.82001 PM3PUK + 13.226 PM3VEK + 2.965 PM3FDK + 28.665 PM3FRU
    + 46.25712 PL3RIB + 7.413 PL3COG + 13.5905 PL3SUG + 19.768 PL3NOK
    + 39.536 PL3PUK <=   786250

PCRFENR)   79.15321 PS3WHE + 87.06853 PS3WHB + 13.26738 PS3BAR
    + 5.97032 PS3PUR + 129.0917 PS3HVA + 42.45563 PS3TOR + 46.43584 PS3NOR
    + 30.51498 PS3FDR + 93.18707 PS3FRU + 96.84925 PM3WHE
    + 106.5342 PM3WHB + 17.2476 PM3BAR + 5.97032 PM3PUR + 152.5683 PM3HVA
    + 42.45563 PM3TOR + 46.43584 PM3NOR + 30.51498 PM3FDR
    + 93.18707 PM3FRU + 98.96042 PL3WHE + 108.8565 PL3WHB
    + 19.90107 PL3BAR + 5.97032 PL3PUR + 141.3242 PL3HVA + 42.45563 PL3TOR
    + 46.43584 PL3NOR + 30.51498 PL3FDR + 93.18707 PL3FRU - A3FENR
    <=   0

PCRFEPR)   33.48658 PS3WHE + 36.83524 PS3WHB + 8.39262 PS3PUR
    + 50.02006 PS3HVA + 16.78525 PS3TOR + 18.24484 PS3NOR + 7.29793 PS3FDR
    + 111.006 PS3FRU + 28.06495 PM3WHE + 30.87144 PM3WHB + 8.39262 PM3PUR
    + 58.66447 PM3HVA + 16.78525 PM3TOR + 18.24484 PM3NOR + 7.29793 PM3FDR
    + 111.006 PM3FRU + 33.24739 PL3WHE + 36.57213 PL3WHB + 8.39262 PL3PUR
    + 53.71282 PL3HVA + 16.78525 PL3TOR + 18.24484 PL3NOR + 7.29793 PL3FDR
    + 111.006 PL3FRU - A3FEPR <=   0
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PCRFEKR)   0.28037 PS3FDR + 6.65889 PM3WHE + 7.32477 PM3WHB
    + 0.28037 PM3FDR + 3.32944 PL3WHE + 3.66238 PL3WHB + 10.51403 PL3HVA
    + 0.28037 PL3FDR - A3FEKR <=   0

PLCFENR)   A3FENR <=   338748

PLCFEPR)   A3FEPR <=   132858

PLCFEKR)   A3FEKR <=   10259

PCRBULR)   62.84247 PS3WHE + 59.70034 PS3WHB + 149.7558 PS3BAR
    + 58.5627 PS3PUR + 3.75592 PS3HVA + 21.2506 PS3TOR + 37.62 PS3NOR
    + 5.93 PS3FDR + 57.325 PS3FRU + 35.09067 PM3WHE + 33.33613 PM3WHB
    + 149.7558 PM3BAR + 49.6671 PM3PUR + 11.8608 PM3TOR + 28.694 PM3NOR
    + 2.965 PM3FDR + 28.665 PM3FRU + 149.7558 PL3BAR + 40.7715 PL3PUR
    + 2.471 PL3TOR + 19.768 PL3NOR <=   786250

 PCRFYM)   1.2355 PS3RIO + 19.768 PS3COG + 18.7796 PS3CO3 + 20.65756 PS3CO4
    + 44.478 PS3SUG + 37.065 PS3FDK + 19.03 PS3WHE + 18.0785 PS3WHB
    + 37.065 PS3FDR + 37.07 PS3FRU + 30.68117 PM3CO3 + 33.74928 PM3CO4
    + 33.1114 PM3SUG + 37.065 PM3FDK + 31.25815 PM3WHE + 29.69524 PM3WHB
    + 37.065 PM3FDR + 37.07 PM3FRU + 1.2355 PL3RIO + 27.51211 PL3CO3
    + 30.26332 PL3CO4 + 2.471 PL3VEK + 37.065 PL3FDK + 37.56414 PL3WHE
    + 35.68593 PL3WHB + 29.652 PL3HVA + 37.065 PL3FDR + 37.07 PL3FRU
    <=   200000

PCRTOWK)   8.74734 PS3RIB + 8.74734 PS3RIO + 3.4594 PS3COG + 4.81227 PS3CO3
    + 5.2935 PS3CO4 + 4.547 PS3SUG + 1.85325 PS3TOK + 3.77445 PS3NOK
    + 1.85325 PS3PUK + 8.85606 PS3VEK + 4.2007 PS3FDK + 5.805 PS3FRU
    + 8.74734 PM3RIB + 8.74734 PM3RIO + 3.4594 PM3COG + 4.83574 PM3CO3
    + 5.31932 PM3CO4 + 4.547 PM3SUG + 1.85325 PM3TOK + 3.77445 PM3NOK
    + 1.85325 PM3PUK + 8.85606 PM3VEK + 4.2007 PM3FDK + 5.805 PM3FRU
    + 8.74734 PL3RIB + 8.74734 PL3RIO + 3.4594 PL3COG + 4.83574 PL3CO3
    + 5.31932 PL3CO4 + 4.547 PL3SUG + 1.85325 PL3TOK + 3.77445 PL3NOK
    + 1.85325 PL3PUK + 8.85606 PL3VEK + 4.2007 PL3FDK + 5.805 PL3FRU
    - IB3CAK - IB3TUK <=   0

PCRTOWR)   4.546 PS3SUG + 4.05244 PS3WHE + 2.64397 PS3WHB + 3.4594 PS3BAR
    + 1.85325 PS3PUR + 3.7065 PS3HVA + 2.59455 PS3TOR + 3.77445 PS3NOR
    + 6.1775 PS3FDR + 5.805 PS3FRU + 4.546 PM3SUG + 3.80534 PM3WHE
    + 2.61926 PM3WHB + 3.4594 PM3BAR + 1.85325 PM3PUR + 3.7065 PM3HVA
    + 2.59455 PM3TOR + 3.77445 PM3NOR + 6.1775 PM3FDR + 5.805 PM3FRU
    + 4.546 PL3SUG + 3.80534 PL3WHE + 2.61926 PL3WHB + 3.4594 PL3BAR
    + 1.85325 PL3PUR + 3.7065 PL3HVA + 2.59455 PL3TOR + 3.77445 PL3NOR
    + 6.1775 PL3FDR + 5.805 PL3FRU - IB3CAR - IB3TUR <=   0

PCRCAWK)   IB3CAK <=   21678

PCRCAWR)   IB3CAR <=   10189

PCRTUWK)   IB3TUK <=   7000

PCRTUWR)   IB3TUR <=   7000
```

PUNJAB COTTON ZONE LIVESTOCK FEED RATION

```
PCFFEED) - 220.2251 PS3RIB - 254.7381 PS3RIO - 357.9338 PS3COG
    - 81.30372 PS3CO3 - 89.4341 PS3CO4 - 326.0593 PS3SUG - 129.5335 PS3PUK
    - 749.3414 PS3VEK - 467.0404 PS3WHE - 451.8366 PS3WHB
    - 205.7371 PS3BAR - 114.2971 PS3PUR - 313.6817 PS3HVA
    - 231.7262 PM3RIB - 268.0018 PM3RIO - 375.8305 PM3COG
    - 80.51052 PM3CO3 - 88.56157 PM3CO4 - 337.9572 PM3SUG
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- 99.64112 PM3PUK - 691.0094 PM3VEK - 472.1954 PM3WHE
- 446.8143 PM3WHB - 208.008 PM3BAR - 115.5586 PM3PUR - 289.2633 PM3HVA
- 230.5741 PL3RIB - 266.6774 PL3RIO - 372.2512 PL3COG
- 86.85617 PL3CO3 - 95.54179 PL3CO4 - 328.4681 PL3SUG
- 158.3187 PL3PUK - 556.3972 PL3VEK - 490.7533 PL3WHE
- 459.8388 PL3WHB - 216.183 PL3BAR - 120 1002 PL3PUR - 232.9134 PL3HVA
+ 526.7 L3MCA1 + 579.4 L3MCA2 + 526.7 L3MCA3 + 31.68 L3NMC1
+ 35.84 L3NMC2 + 31.68 L3NMC3 + 13.67 L3GOS1 + 15.03 L3GOS2
+ 14.35 L3GOS3 + 12.58465 L3BRO1 + 15.73081 L3BRO2 + 15.10158 L3BRO3
+ 13.1318 L3BRO4 + 12.58465 L3LAY1 + 15.73081 L3LAY2 + 15.10158 L3LAY3
+ 10.94317 L3LAY4 + 4.88656 L3DESI <= 0

PCFCAKE) 123.18 L3MCA1 + 123.18 L3MCA2 + 135.48 L3MCA3 + 3.6588 L3NMC1
+ 3.6588 L3NMC2 + 4.02 L3NMC3 + 0.32304 L3BRO1 + 0.4038 L3BRO2
+ 0.38765 L3BRO3 + 0.33709 L3BRO4 + 0.32304 L3LAY1 + 0.4038 L3LAY2
+ 0.38765 L3LAY3 + 0.28091 L3LAY4 - DF3CAK <= 0

PCFSTRAW) - 2799.676 PS3RIB - 2158.782 PS3RIO - 1342.252 PS3COG
- 3260.594 PS3SUG - 887.5949 PS3TOK - 1247.207 PS3NOK
- 539.7227 PS3PUK - 1498.683 PS3VEK - 2484.258 PS3WHE
- 2360.045 PS3WHB - 857.2381 PS3BAR - 482.6734 PS3PUR
- 1235.906 PS3TOR - 1316.767 PS3NOR - 2945.493 PM3RIB
- 2271.218 PM3RIO - 1409.365 PM3COG - 3379.572 PM3SUG
- 682.7653 PM3TOK - 959.3898 PM3NOK - 415.1713 PM3PUK
- 1382.019 PM3VEK - 2511.678 PM3WHE - 2386.094 PM3WHB
- 866.6999 PM3BAR - 488.0009 PM3PUR - 950.6967 PM3TOR
- 1012.898 PM3NOR - 2930.911 PL3RIB - 2259.975 PL3RIO
- 1395.942 PL3COG - 3284.681 PL3SUG - 1084.838 PL3TOK
- 1524.364 PL3NOK - 659.6611 PL3PUK - 1112.795 PL3VEK - 2610.39 PL3WHE
- 2479.871 PL3WHB - 900.7623 PL3BAR - 507.18 PL3PUR - 1510.552 PL3TOR
- 1609.382 PL3NOR + 766.16 L3MCA1 + 843.2 L3MCA2 + 766.16 L3MCA3
+ 766.16 L3NMC1 + 843.2 L3NMC2 + 766.16 L3NMC3 + 147.44 L3GOS1
+ 162.16 L3GOS2 + 154.8 L3GOS3 <= 0

PCFGREK) - 37.32901 PS3RIB - 43.17562 PS3RIO - 17.89669 PS3COG
- 25.01653 PS3CO3 - 27.51818 PS3CO4 - 10759.96 PS3SUG
- 88.75949 PS3TOK - 249.4413 PS3NOK - 53.97227 PS3PUK
- 1498.683 PS3VEK - 12555.76 PS3FDK - 395.2965 PS3FRU
- 39.27323 PM3RIB - 45.42435 PM3RIO - 18.79152 PM3COG
- 24.77246 PM3CO3 - 27.24971 PM3CO4 - 11152.59 PM3SUG
- 68.27653 PM3TOK - 191.878 PM3NOK - 41.51713 PM3PUK - 1382.019 PM3VEK
- 11927.98 PM3FDK - 391.44 PM3FRU - 39.07881 PL3RIB - 45.19948 PL3RIO
- 18.61256 PL3COG - 26.72497 PL3CO3 - 29.39747 PL3CO4
- 10839.45 PL3SUG - 108.4838 PL3TOK - 304.8728 PL3NOK
- 65.96611 PL3PUK - 1112.795 PL3VEK - 11300.19 PL3FDK
- 422.2924 PL3FRU + 851.7425 L3MCA1 + 852 L3MCA2 + 851.7425 L3MCA3
+ 851.7425 L3NMC1 + 852 L3NMC2 + 851.7425 L3NMC3 + 163.8824 L3GOS1
+ 163.92 L3GOS2 + 163.84 L3GOS3 <= 0

PCFGRER) - 99.3703 PS3WHE - 94.40178 PS3WHB - 34.28952 PS3BAR
- 19.30693 PS3PUR - 627.3634 PS3HVA - 247.1811 PS3TOR
- 263.3533 PS3NOR - 27282.48 PS3FDR - 395.2965 PS3FRU
- 100.4671 PM3WHE - 95.44375 PM3WHB - 34.66799 PM3BAR
- 19.52003 PM3PUR - 578.5267 PM3HVA - 190.1393 PM3TOR
- 202.5795 PM3NOR - 25918.36 PM3FDR - 391.44 PM3FRU - 104.4156 PL3WHE
- 99.19481 PL3WHB - 36.03049 PL3BAR - 20.28719 PL3PUR
- 465.8267 PL3HVA - 302.1103 PL3TOR - 321.8763 PL3NOR
- 24554.23 PL3FDR - 422.2924 PL3FRU + 1394.099 L3MCA1 + 1394 L3MCA2
+ 1394.099 L3MCA3 + 1394.099 L3NMC1 + 1394 L3NMC2 + 1394.099 L3NMC3
+ 268.2363 L3GOS1 + 268.2 L3GOS2 + 268.2363 L3GOS3 <= 0

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PCFPAST) 3.764 L3MCA1 + 3.764 L3MCA2 + 3.764 L3MCA3 + 3.764 L3NMC1
+ 3.764 L3NMC2 + 3.764 L3NMC3 + 2.602 L3GOS1 + 2.602 L3GOS2
+ 2.602 L3GOS3 <= 37777

PCFFISHM) 1.891 L3BRO1 + 2.363 L3BRO2 + 1.891 L3BRO3 + 1.973 L3BRO4
+ 1.891 L3LAY1 + 2.363 L3LAY2 + 1.891 L3LAY3 + 1.644 L3LAY4
<= 33450

PUNJAB COTTON ZONE HERD LEVELS

PCHLMCA) L3MCA1 + L3MCA2 + L3MCA3 = 3391.999

PCHLNMCA) L3NMC1 + L3NMC2 + L3NMC3 = 5639.998

PCHLGOSH) L3GOS1 + L3GOS2 + L3GOS3 = 1451.996

PCHLBRO) L3BRO1 + L3BRO2 + L3BRO3 + L3BRO4 = 13290.03

PCHLLAY) L3LAY1 + L3LAY2 + L3LAY3 + L3LAY4 = 4429.997

PCHLDESI) L3DESI = 11460

SIND PRODUCTION ROWS

SIPRIO) - 2411.2 PS4RIO - 2536.8 PM4RIO - 2524.8 PL4RIO - 1460 PS5RIO
- 1556 PM5RIO - 1528 PL5RIO + MSIRIO + MXSRIO <= 0

SIPCOG) - 306.582 PS4COG - 357.935 PS4BAR - 313.834 PM4COG
- 361.845 PM4BAR - 320.938 PL4COG - 376.125 PL4BAR - 358.974 PS5COG
- 432.82 PS5BAR - 377.622 PM5COG - 437.58 PM5BAR - 375.772 PL5COG
- 454.835 PL5BAR + MSICOG <= 0

SIPCOT) - 198.927 PS4CO3 - 218.829 PS4CO4 - 192.975 PM4CO3
- 212.319 PM4CO4 - 189.069 PL4CO3 - 207.948 PL4CO4 - 358.236 PS5CO3
- 394.041 PS5CO4 - 347.541 PM5CO3 - 382.23 PM5CO4 - 340.38 PL5CO3
- 374.418 PL5CO4 + MSICTF + MXSCTF <= 0

SIPSUG) - 44661.87 PS4SUG - 44226.27 PM4SUG - 47712.06 PL4SUG
- 44854.92 PS5SUG - 44417.34 PM5SUG - 47917.98 PL5SUG + MSISUG
<= 0

SIPTOL) - 366.983 PS4TOK - 525.687 PS4TOR - 380.3741 PM4TOK
- 404.3746 PM4TOR - 369.6941 PL4TOK - 642.5063 PL4TOR
- 1570.822 PS5TOK - 591.8509 PS5TOR - 1628.141 PM5TOK
- 455.2699 PM5TOR - 1582.427 PL5TOK - 723.3733 PL5TOR + MSITOL
<= 0

SIPNOK) - 616.7962 PS4NOK - 639.303 PM4NOK - 621.3528 PL4NOK
- 614.5615 PS5NOK - 636.9868 PM5NOK - 619.1016 PL5NOK + MSINOK
<= 0

SIPPUL) - 315.932 PS4PUK - 420.2176 PS4PUR - 243.048 PM4PUK
- 424.654 PM4PUR - 386.156 PL4PUK - 441.5488 PL4PUR - 321.936 PS5PUK
- 463.936 PS5PUR - 247.57 PM5PUK - 469.04 PM5PUR - 393.49 PL5PUK
- 487.52 PL5PUR + MSIPUL <= 0

SIPHVA) - 3808.441 PS4VEK - 8213.703 PS4HVA - 2929.57 PM4VEK
- 7574.314 PM4HVA - 4654.761 PL4VEK - 6098.798 PL4HVA
- 1607.232 PS5VEK - 8683.047 PS5HVA - 1236.332 PM5VEK
- 8007.121 PM5HVA - 1964.395 PL5VEK - 6447.292 PL5HVA + MSIVEG
+ MXSVEG <= 0

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```
SIPWHE) - 1134.495 PS4WHE - 1078.057 PS4WHL - 1147.887 PM4WHE
   - 1090.493 PM4WHL - 1192.846 PL4WHE - 1311.461 PL4WHL
   - 1948.538 PS5WHE - 1850.967 PS5WHL - 1969.582 PM5WHE
   - 1871.055 PM5WHL - 2047.065 PL5WHE - 1944.712 PL5WHL + MSIWHE
   <=   0

SIPNOR) - 616.3138 PS4NOR - 638.803 PM4NOR - 620.8668 PL4NOR
   - 615.7817 PS5NOR - 638.2515 PM5NOR - 620.3309 PL5NOR + MSINOR
   <=   0

SIPFRU) - 8137.714 PS4FRU - 7730.828 PM4FRU - 7323.943 PL4FRU
   - 7974.875 PS5FRU - 7576.131 PM5FRU - 7177.387 PL5FRU + MSIFRU
   + MXSFRU <=   0

SIPMCA) - 1075 L4MCA1 - 1183 L4MCA2 - 1129 L4MCA3 - 1075 L5MCA1
   - 1183 L5MCA2 - 1129 L5MCA3 + MSINMC + MSIMCA + MSIBUT + MSIAGE
   <=   0

SIPNMC) - 167 L4NMC1 - 183.7 L4NMC2 - 175.4 L4NMC3 - 167 L5NMC1
   - 183.7 L5NMC2 - 175.4 L5NMC3 + MSINMC + MSIMCA <=   0

SIPGOS) - 164 L4GOS1 - 180.4 L4GOS2 - 172.2 L4GOS3 - 164 L5GOS1
   - 180.4 L5GOS2 - 172.2 L5GOS3 + MSIGOS <=   0

SIPPOU) - 0.909 L4BRO1 - 0.909 L4BRO2 - 1.092 L4BRO3 - 0.909 L4BRO4
   - 1.364 L4LAY1 - 1.364 L4LAY2 - 1.638 L4LAY3 - 1.364 L4LAY4
   - 1.136 L4DESI - 0.909 L5BRO2 - 1.092 L5BRO3 - 0.909 L5BRO4
   - 1.364 L5LAY1 - 1.364 L5LAY2 - 1.638 L5LAY3 - 1.364 L5LAY4
   - 1.136 L5DESI + MSIPOU <=   0

SIPEGG) - 133 L4LAY1 - 133 L4LAY2 - 160 L4LAY3 - 133 L4LAY4 - 89 L4DESI
   - 133 L5LAY1 - 133 L5LAY2 - 160 L5LAY3 - 133 L5LAY4 - 89 L5DESI
   + MSIEGG <=   0
```

SIND INPUT BALANCES

```
SIIFEN)   A4FENK + A4FENR + A5FENK + A5FENR - ISIFEN <=   0

SIIFEP)   A4FEPK + A4FEPR + A5FEPK + A5FEPR - ISIFEP <=   0

SIIFEK)   A4FEKK + A4FEKR + A5FEKK + A5FEKR - ISIFEK <=   0

 SIIHL)   ASIHLK + ASIHLR - ISIHL <=   0

SIITTR)   6 PS4RIO + 4.752 PS4COG + 6.31845 PS4CO3 + 6.95029 PS4CO4
   + 1.53886 PS4TOK + 5.226 PS4NOK + 2.33337 PS4PUK + 7.602 PS4VEK
   + 2.373 PS4FDK + 3.11809 PS4BAR + 5.6833 PS4PUR + 10.3782 PS4HVA
   + 6.30105 PS4TOR + 5.226 PS4NOR + 2.373 PS4FDR + 32.56 PS4FRU
   + 13.5905 PM4RIO + 6.336 PM4COG + 9.01146 PM4CO3 + 9.9126 PM4CO4
   + 14.826 PM4SUG + 2.05182 PM4TOK + 6.968 PM4NOK + 3.11116 PM4PUK
   + 10.136 PM4VEK + 3.164 PM4FDK + 6.93115 PM4WHE + 6.58459 PM4WHL
   + 4.15745 PM4BAR + 7.57773 PM4PUR + 13.8376 PM4HVA + 8.4014 PM4TOR
   + 6.968 PM4NOR + 3.164 PM4FDR + 43.42 PM4FRU + 12.18203 PL4RIO
   + 7.92 PL4COG + 11.70447 PL4CO3 + 12.87492 PL4CO4 + 23.69689 PL4SUG
   + 2.56477 PL4TOK + 8.71 PL4NOK + 3.88895 PL4PUK + 12.67 PL4VEK
   + 3.955 PL4FDK + 12.04118 PL4WHE + 11.43912 PL4WHL + 5.19682 PL4BAR
   + 9.47216 PL4PUR + 17.297 PL4HVA + 10.50175 PL4TOR + 8.71 PL4NOR
   + 3.955 PL4FDR + 54.27 PL4FRU + 9.978 PS5RIO + 36.50284 PS5CO3
   + 40.15313 PS5CO4 + 58.0685 PS5SUG + 1.53886 PS5TOK + 5.226 PS5NOK
   + 2.33337 PS5PUK + 7.602 PS5VEK + 2.373 PS5FDK + 6.79525 PS5WHE
   + 6.45548 PS5WHL + 3.11809 PS5BAR + 5.6833 PS5PUR + 12.72565 PS5HVA
   + 6.30105 PS5TOR + 5.226 PS5NOR + 2.373 PS5FDR + 32.56 PS5FRU
```


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```
    + 8.52495 PM5RIO + 4.942 PM5COG + 9.17853 PM5CO3 + 10.09638 PM5CO4
    + 29.42961 PM5SUG + 2.05182 PM5TOK + 6.968 PM5NOK + 3.11116 PM5PUK
    + 10.136 PM5VEK + 3.164 PM5FDK + 6.36035 PM5WHE + 6.04233 PM5WHL
    + 4.15745 PM5BAR + 7.57773 PM5PUR + 14.25767 PM5HVA + 8.4014 PM5TOR
    + 6.968 PM5NOR + 3.164 PM5FDR + 43.42 PM5FRU + 16.63 PL5RIO
    + 17.93451 PL5CO3 + 19.72797 PL5CO4 + 2.56477 PL5TOK + 8.71 PL5NOK
    + 3.88895 PL5PUK + 12.67 PL5VEK + 3.955 PL5FDK + 11.17139 PL5WHE
    + 10.61282 PL5WHL + 5.19682 PL5BAR + 9.47216 PL5PUR + 16.01208 PL5HVA
    + 10.50175 PL5TOR + 8.71 PL5NOR + 3.955 PL5FDR + 54.27 PL5FRU - ISITTR
    <=   0
```

SIND REGIONAL RESOURCE RESTRICTIONS

```
SIRHLK)   86.9792 PS4RIO + 108.724 PS4COG + 116.4335 PS4CO3
    + 128.0769 PS4CO4 + 133.43 PS4SUG + 264.1069 PS4TOK + 173.9584 PS4NOK
    + 75.1184 PS4PUK + 193.7264 PS4VEK + 181.9645 PS4FDK + 20 PS4FRU
    + 158.144 PM4RIO + 158.144 PM4COG + 175.0259 PM4CO3 + 192.5285 PM4CO4
    + 247.1 PM4SUG + 528.2138 PM4TOK + 267.8564 PM4NOK + 119.6755 PM4PUK
    + 271.81 PM4VEK + 382.2143 PM4FDK + 48.88 PM4FRU + 59.304 PL4RIO
    + 216.4596 PL4COG + 205.6366 PL4CO3 + 226.2003 PL4CO4 + 607.15 PL4SUG
    + 897.9634 PL4TOK + 370.65 PL4NOK + 174.1166 PL4PUK + 356.8124 PL4VEK
    + 752.5678 PL4FDK + 155.52 PL4FRU + 134.4224 PS5RIO + 525.8288 PS5CO3
    + 578.4117 PS5CO4 + 154.4375 PS5SUG + 264.1069 PS5TOK
    + 173.9584 PS5NOK + 75.1184 PS5PUK + 193.7264 PS5VEK + 181.9645 PS5FDK
    + 20 PS5FRU + 197.68 PM5RIO + 51.891 PM5COG + 597.2617 PM5CO3
    + 656.9879 PM5CO4 + 134.4224 PM5SUG + 528.2138 PM5TOK
    + 267.8564 PM5NOK + 119.6755 PM5PUK + 271.81 PM5VEK + 382.2143 PM5FDK
    + 48.88 PM5FRU + 310.3576 PL5RIO + 477.8 PL5CO3 + 525.58 PL5CO4
    + 988.4 PL5SUG + 897.9634 PL5TOK + 370.65 PL5NOK + 174.1166 PL5PUK
    + 356.8124 PL5VEK + 752.5678 PL5FDK + 155.52 PL5FRU - ASIHLK <=   0

SIRHLR)   4.4305 PS4WHE + 4.20897 PS4WHL + 71.19148 PS4BAR
    + 15.8144 PS4PUR + 268.8448 PS4HVA + 27.6752 PS4TOR + 173.9584 PS4NOR
    + 181.9645 PS4FDR + 20 PS4FRU + 49.52378 PM4WHE + 47.04759 PM4WHL
    + 82.06833 PM4BAR + 35.0882 PM4PUR + 441.8148 PM4HVA + 60.2924 PM4TOR
    + 267.8564 PM4NOR + 382.2143 PM4FDR + 48.88 PM4FRU + 43.95167 PL4WHE
    + 41.75409 PL4WHL + 100.8568 PL4BAR + 51.891 PL4PUR + 601.9356 PL4HVA
    + 87.9676 PL4TOR + 370.65 PL4NOR + 752.5678 PL4FDR + 155.52 PL4FRU
    + 94.86169 PS5WHE + 90.1186 PS5WHL + 71.19148 PS5BAR + 15.8144 PS5PUR
    + 152.8067 PS5HVA + 27.6752 PS5TOR + 173.9584 PS5NOR + 181.9645 PS5FDR
    + 20 PS5FRU + 66.59345 PM5WHE + 63.26377 PM5WHL + 82.06833 PM5BAR
    + 35.0882 PM5PUR + 253.6235 PM5HVA + 60.2924 PM5TOR + 267.8564 PM5NOR
    + 382.2143 PM5FDR + 48.88 PM5FRU + 85.72887 PL5WHE + 81.44243 PL5WHL
    + 100.8568 PL5BAR + 51.891 PL5PUR + 263.3098 PL5HVA + 87.9676 PL5TOR
    + 370.65 PL5NOR + 752.5678 PL5FDR + 155.52 PL5FRU - ASIHLR <=   0

SLIHLK)   ASIHLK <=   600000

SLIHLR)   ASIHLR <=   262385
```

SIND RICE ZONE
SMALL FARM RESOURCE RESTRICTIONS

```
SRSRFALK)   515.8954 PS4RIO + 197.0888 PS4COG + 221.3569 PS4CO3
    + 243.4925 PS4CO4 + 1302.538 PS4SUG + 797.6753 PS4TOK
    + 357.8616 PS4NOK + 205.655 PS4PUK + 257.7376 PS4VEK + 1678.204 PS4FDK
    + 206.77 PS4FRU <=   1726575

SRSRLAK)   PS4RIO + PS4COG + PS4CO3 + PS4CO4 + PS4SUG + PS4TOK + PS4NOK
    + PS4PUK + PS4VEK + PS4FDK + PS4FRU <=   444

SRSRFALR)   248.9705 PS4WHE + 273.8676 PS4WHL + 187.3328 PS4BAR
```


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```
     + 121.8203 PS4PUR + 482.3392 PS4HVA + 131.9514 PS4TOR
     + 357.8616 PS4NOR + 1678.204 PS4FDR + 206.77 PS4FRU <=   1726575

 SRSRLAR)   PS4SUG + PS4WHE + PS4WHL + PS4BAR + PS4PUR + PS4HVA + PS4TOR
     + PS4NOR + PS4FDR + PS4FRU <=   368

SRSROBCW)   PS4CO4 + PS4WHE <=   368

SRSMKTSW)   1483.25 PS4WHE + 1409.087 PS4WHL + HS4WHE >=   343100

SRSMKTSR)   3417.98 PS4RIO + HS4RIC >=   124334
```

SIND RICE ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

```
SRMRFALK)   405.244 PM4RIO + 138.0804 PM4COG + 145.0451 PM4CO3
     + 159.5496 PM4CO4 + 1231.176 PM4SUG + 530.8911 PM4TOK
     + 255.0376 PM4NOK + 156.8139 PM4PUK + 166.428 PM4VEK + 1474.989 PM4FDK
     + 162.265 PM4FRU <=   408437

 SRMRLAK)   PM4RIO + PM4COG + PM4CO3 + PM4CO4 + PM4SUG + PM4TOK + PM4NOK
     + PM4PUK + PM4VEK + PM4FDK + PM4FRU <=   189

SRMRFALR)   157.0444 PM4WHE + 172.7489 PM4WHL + 176.4559 PM4BAR
     + 84.7553 PM4PUR + 294.5432 PM4HVA + 72.1532 PM4TOR + 255.0376 PM4NOR
     + 1474.989 PM4FDR + 162.265 PM4FRU <=   408437

 SRMRLAR)   PM4SUG + PM4WHE + PM4WHL + PM4BAR + PM4PUR + PM4HVA + PM4TOR
     + PM4NOR + PM4FDR + PM4FRU <=   107

SRMROBCW)   PM4CO4 + PM4WHE <=   107

SRMMKTSW)   1499.621 PM4WHE + 1424.64 PM4WHL + HM4WHE >=   81163

SRMMKTSR)   3596 PM4RIO + HM4RIC >=   29412
```

SIND RICE ZONE
LARGE FARM RESOURCE RESTRICTIONS

```
SRLRFALK)   268.2518 PL4RIO + 70.1764 PL4COG + 57.27778 PL4CO3
     + 63.00555 PL4CO4 + 917.3835 PL4SUG + 158.4641 PL4TOK + 143.318 PL4NOK
     + 98.08881 PL4PUK + 68.1996 PL4VEK + 1101.671 PL4FDK + 40 PL4FRU
     <=   196792

 SRLRLAK)   PL4RIO + PL4COG + PL4CO3 + PL4CO4 + PL4SUG + PL4TOK + PL4NOK
     + PL4PUK + PL4VEK + PL4FDK + PL4FRU <=   170

SRLRFALR)   82.88846 PL4WHE + 91.1773 PL4WHL + 157.6674 PL4BAR
     + 58.0685 PL4PUR + 119.5964 PL4HVA + 33.1114 PL4TOR + 143.318 PL4NOR
     + 1101.671 PL4FDR + 40 PL4FRU <=   196792

 SRLRLAR)   PL4SUG + PL4WHE + PL4WHL + PL4BAR + PL4PUR + PL4HVA + PL4TOR
     + PL4NOR + PL4FDR + PL4FRU <=   117

SRLROBCW)   PL4CO4 + PL4WHE <=   117

SRLMKTSW)   1558.558 PL4WHE + 1714.414 PL4WHL + HL4WHE >=   39106

SRLMKTSR)   3578.198 PL4RIO + HL4RIC >=   14171
```

SIND RICE ZONE
ZONAL RESOURCE RESTRICTIONS

```
SRRFENK)   20.53 PS4RIO + 12.45 PS4COG + 27.16 PS4CO3 + 31.16 PS4CO4
    + 11.52 PS4SUG + 2.73  PS4TOK +  6.07 PS4NOK + 75.32 PS4VEK
    + 13.97 PS4FDK + 21.8  PS4FRU +  9.72 PM4RIO + 12.45 PM4COG
    + 27.16 PM4CO3 + 31.16 PM4CO4 + 26.42 PM4SUG + 2.73 PM4TOK
    + 6.07  PM4NOK + 75.32 PM4VEK + 13.97 PM4FDK + 21.8 PM4FRU
    + 31.59 PL4RIO + 12.45 PL4COG + 27.16 PL4CO3 + 31.66 PL4CO4
    + 23.53 PL4SUG +  2.73 PL4TOK +  6.07 PL4NOK + 75.32 PL4VEK
    + 13.97 PL4FDK + 21.8  PL4FRU - A4FENK <=   0

SRRFEPK)   7.73 PS4RIO + 9.66 PS4COG + 10.66 PS4CO3 + 8.66 PS4CO4
    + 5.35 PS4SUG + 3.22 PS4TOK + 12.89 PS4VEK + 2.8 PS4FDK + 6.74 PS4FRU
    + 3.22 PM4RIO + 9.66 PM4COG + 8.6 PM4CO3 + 10.66 PM4CO4 + 6.44 PM4SUG
    + 3.22 PM4TOK + 12.89 PM4VEK + 2.8 PM4FDK + 6.37 PM4FRU + 9.66 PL4RIO
    + 9.66 PL4COG + 8.66 PL4CO3 + 10.66 PL4CO4 + 10.12 PL4SUG
    + 3.22 PL4TOK + 12.89 PL4VEK + 2.8 PL4FDK + 6.37 PL4FRU - A4FEPK
    <=   0

SRRFEKK)   2.68 PS4TOK + 2.68 PS4VEK + 0.43 PS4FDK + 10.72 PM4SUG
    + 2.68 PM4TOK + 2.68 PM4VEK + 0.43 PM4FDK + 5.36 PL4RIO + 2.68 PL4TOK
    + 0.43 PL4FDK - A4FEKK <=   0

SLRFENK)   A4FENK <=   16173.05

SLRFEPK)   A4FEPK <=   5747

SLRFEKK)   A4FEKK <=   870

SRRBULK)   51.6439 PS4RIO + 36.968 PS4COG + 26.049 PS4CO3 + 28.6539 PS4CO4
    + 65.4815 PS4SUG + 5.35465 PS4TOK + 37.62 PS4NOK + 48.10402 PS4PUK
    + 26.452 PS4VEK + 5.93 PS4FDK + 31.255 PS4FRU + 4.942 PM4RIO
    + 28.368 PM4COG + 13.0245 PM4CO3 + 14.32695 PM4CO4 + 17.297 PM4SUG
    + 2.67732 PM4TOK + 28.694 PM4NOK + 43.82001 PM4PUK + 13.226 PM4VEX
    + 2.965 PM4FDK + 16.125 PM4FRU + 19.768 PL4COG + 74.13 PL4SUG
    + 19.768 PL4NOK + 39.536 PL4PUK <=   279200

SRRFENR)   232.9 PS4WHE + 212.9 PS4WHL + 68.69 PS4BAR + 30.91 PS4PUR
    + 597.6 PS4HVA + 219.8 PS4TOR + 68.69 PS4NOR + 158 PS4FDR
    + 21.8 PS4FRU + 229.8 PM4WHE + 209.8 PM4WHL + 89.3 PM4BAR
    + 30.91 PM4PUR + 597.6 PM4HVA + 219.8 PM4TOR + 68.69 PM4NOR
    + 158 PM4FDR + 21.8 PM4FRU + 262.1 PL4WHE + 242.1 PL4WHL + 103 PL4BAR
    + 30.91 PL4PUR + 597.6 PL4HVA + 219.8 PL4TOR + 68.69 PL4NOR
    + 158 PL4FDR + 21.8 PL4FRU - A4FENR <=   0

SRRFEPR)   58 PS4WHE + 54 PS4WHL + 26.85 PS4PUR + 107.4 PS4HVA
    + 53.7 PS4TOR + 23.34 PS4FDR + 6.74 PS4FRU + 58.69 PM4WHE
    + 48.69 PM4WHL + 26.85 PM4PUR + 107.4 PM4HVA + 53.69 PM4TOR
    + 23.34 PM4FDR + 6.37 PM4FRU + 69.89 PL4WHE + 57.89 PL4WHL
    + 26.85 PL4PUR + 107.4 PL4HVA + 53.69 PL4TOR + 23.34 PL4FDR
    + 6.37 PL4FRU - A4FEPR <=   0

SRRFEKR)   17.62 PS4HVA + 0.7 PS4FDR + 17.62 PM4HVA + 0.7 PM4FDR
    + 16.12 PL4WHE + 14.12 PL4WHL + 17.62 PL4HVA + 0.7 PL4FDR - A4FEKR
    <=   0

SLRFENR)   A4FENR <=   84638

SLRFEPR)   A4FEPR <=   21946

SLRFEKR)   A4FEKR <=   1922
```


300

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SRRBULR)   66.53908 PS4WHE + 63.21213 PS4WHL + 149.7558 PS4BAR
    + 58.5627 PS4PUR + 29.652 PS4HVA + 21.2506 PS4TOR + 37.62 PS4NOR
    + 5.93 PS4FDR + 31.255 PS4FRU + 37.1836 PM4WHE + 35.32442 PM4WHL
    + 149.7558 PM4BAR + 49.6671 PM4PUR + 14.826 PM4HVA + 11.8608 PM4TOR
    + 28.694 PM4NOR + 2.965 PM4FDR + 16.125 PM4FRU + 149.7558 PL4BAR
    + 40.7715 PL4PUR + 2.471 PL4TOR + 19.768 PL4NOR <=   279200

 SRRFYM)   32.123 PS4SUG + 37.065 PS4FDK + 35.3353 PS4WHE + 33.56853 PS4WHL
    + 148.26 PS4HVA + 37.065 PS4FDR + 14.36 PS4FRU + 4.942 PM4RIO
    + 24.71 PM4SUG + 37.065 PM4FDK + 1.35905 PM4WHE + 1.29109 PM4WHL
    + 148.26 PM4HVA + 37.065 PM4FDR + 14.36 PM4FRU + 29.80026 PL4SUG
    + 2.471 PL4VEK + 37.065 PL4FDK + 4.4305 PL4WHE + 4.20897 PL4WHL
    + 148.26 PL4HVA + 37.065 PL4FDR + 14.36 PL4FRU <=   29390

SRRTOWK)   10.5141 PS4RIO + 4.73196 PS4COG + 4.92964 PS4CO3
    + 5.42261 PS4CO4 + 6.21 PS4SUG + 1.9768 PS4TOK + 3.77445 PS4NOK
    + 1.9768 PS4PUK + 6.79772 PS4VEK + 4.74432 PS4FDK + 6.25 PS4FRU
    + 10.5141 PM4RIO + 4.73196 PM4COG + 4.92964 PM4CO3 + 5.42261 PM4CO4
    + 6.21 PM4SUG + 1.9768 PM4TOK + 3.77445 PM4NOK + 1.9768 PM4PUK
    + 6.79772 PM4VEK + 4.74432 PM4FDK + 6.25 PM4FRU + 10.5141 PL4RIO
    + 4.73196 PL4COG + 4.92964 PL4CO3 + 5.42261 PL4CO4 + 6.21 PL4SUG
    + 1.9768 PL4TOK + 3.77445 PL4NOK + 1.9768 PL4PUK + 6.79772 PL4VEK
    + 4.74432 PL4FDK + 6.25 PL4FRU - IB4CAK - IB4TUK <=   0

SRRTOWR)   6.21 PS4SUG + 3.71885 PS4WHE + 2.471 PS4WHL + 4.73196 PS4BAR
    + 1.9768 PS4PUR + 4.32425 PS4HVA + 2.94049 PS4TOR + 3.77445 PS4NOR
    + 4.67019 PS4FDR + 6.25 PS4FRU + 6.21 PM4SUG + 2.33509 PM4WHE
    + 2.52042 PM4WHL + 4.73196 PM4BAR + 1.9768 PM4PUR + 4.32425 PM4HVA
    + 2.94049 PM4TOR + 3.77445 PM4NOR + 4.67019 PM4FDR + 6.25 PM4FRU
    + 6.21 PL4SUG + 2.33509 PL4WHE + 2.52042 PL4WHL + 4.73196 PL4BAR
    + 1.9768 PL4PUR + 4.32425 PL4HVA + 2.94049 PL4TOR + 3.77445 PL4NOR
    + 4.67019 PL4FDR + 6.25 PL4FRU - IB4CAR - IB4TUR <=   0

SRRCAWK)   IB4CAK <=   12915

SRRCAWR)   IB4CAR <=   5635


SRRTUWK)   IB4TUK <=   425

SRRTUWR)   IB4TUR <=   425
```

SIND RICE ZONE LIVESTOCK FEED RATIONS

```
SRFFEED) - 403.318 PS4RIO - 175.1646 PS4COG - 43.05464 PS4CO3
    - 44.9921 PS4CO4 - 451.13 PS4SUG - 99.77586 PS4PUK - 200.4442 PS4VEK
    - 348.5424 PS4WHE - 331.1471 PS4WHL - 136.6111 PS4BAR
    - 176.6849 PS4PUR - 432.3002 PS4HVA - 424.32 PM4RIO - 179.2673 PM4COG
    - 41.763 PM4CO3 - 43.64233 PM4CO4 - 446.73 PM4SUG - 76.75189 PM4PUK
    - 154.1879 PM4VEK - 352.4861 PM4WHE - 334.8618 PM4WHL
    - 138.1118 PM4BAR - 178.6361 PM4PUR - 398.6481 PM4HVA
    - 422.2198 PL4RIO - 183.3701 PL4COG - 40.90191 PL4CO3
    - 42.74249 PL4CO4 - 481.94 PL4SUG - 121.9492 PL4PUK - 244.9874 PL4VEK
    - 366.3221 PL4WHE - 367.8123 PL4WHL - 143.5502 PL4BAR - 185.655 PL4PUR
    - 320.9894 PL4HVA + 239.459 L4MCA1 + 263.4 L4MCA2 + 239.5 L4MCA3
    + 13.84056 L4NMC1 + 15.22 L4NMC2 + 13.84 L4NMC3 + 5.00223 L4GOS1
    + 5.503 L4GOS2 + 5.252 L4GOS3 + 10.43478 L4BRO1 + 13.04347 L4BRO2
    + 12.52173 L4BRO3 + 10.88846 L4BRO4 + 10.43478 L4LAY1
    + 13.04347 L4LAY2 + 12.52173 L4LAY3 + 9.07372 L4LAY4 + 4.8951 L4DESI
    <=   0
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301

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SRFCAKE)   136.838 L4MCA1 + 136.8 L4MCA2 + 150.56 L4MCA3 + 4.87843 L4NMC1
     + 4.8784 L4NMC2 + 5.3656 L4NMC3 + 0.43072 L4BRO1 + 0.53841 L4BRO2
     + 0.51687 L4BRO3 + 0.44945 L4BRO4 + 0.43072 L4LAY1 + 0.53841 L4LAY2
     + 0.51687 L4LAY3 + 0.37454 L4LAY4 - DF4CAK <=   0

SRFSTRAW) - 3417.98 PS4RIO - 722.6417 PS4COG - 4511.321 PS4SUG
     - 366.983 PS4TOK - 770.9952 PS4NOK - 415.7393 PS4PUK - 400.8885 PS4VEK
     - 1854.062 PS4WHE - 1761.359 PS4WHL - 612.0509 PS4BAR
     - 746.1403 PS4PUR - 657.1087 PS4TOR - 770.3923 PS4NOR - 3596 PM4RIO
     - 4467.308 PM4SUG - 380.3741 PM4TOK - 799.1287 PM4NOK
     - 319.7995 PM4PUK - 308.3757 PM4VEK - 1874.526 PM4WHE - 1780.8 PM4WHL
     - 618.8065 PM4BAR - 754.3758 PM4PUR - 505.4682 PM4TOR
     - 798.5037 PM4NOR - 3578.198 PL4RIO - 755.5155 PL4COG
     - 4819.411 PL4SUG - 369.6941 PL4TOK - 776.691 PL4NOK - 508.1258 PL4PUK
     - 489.9748 PL4VEK - 1948.197 PL4WHE - 1850.788 PL4WHL
     - 643.1264 PL4BAR - 784.0238 PL4PUR - 803.1329 PL4TOR
     - 776.0836 PL4NOR + 790.2373 L4MCA1 + 869.6 L4MCA2 + 790.24 L4MCA3
     + 790.2373 L4NMC1 + 869.6 L4NMC2 + 790.24 L4NMC3 + 125.4483 L4GOS1
     + 138 L4GOS2 + 131.76 L4GOS3 <=   0

SRFGREK) - 68.35959 PS4RIO - 9.635219 PS4COG - 13.24758 PS4CO3
     - 13.84372 PS4CO4 - 14887.36 PS4SUG - 36.69829 PS4TOK - 154.199 PS4NOK
     - 41.57393 PS4PUK - 400.8885 PS4VEK - 17467 PS4FDK - 406.8857 PS4FRU
     - 71.91999 PM4RIO - 12.85015 PM4CO3 - 13.42841 PM4CO4
     - 14742.12 PM4SUG - 38.03741 PM4TOK - 159.8257 PM4NOK
     - 31.97994 PM4PUK - 308.3757 PM4VEK - 386.5414 PM4FRU
     - 71.56395 PL4RIO - 10.08687 PL4COG - 12.5852 PL4CO3 - 13.15153 PL4CO4
     - 15904.06 PL4SUG - 36.9694 PL4TOK - 155.3382 PL4NOK - 50.81258 PL4PUK
     - 489.9748 PL4VEK - 366.1971 PL4FRU + 481.3888 L4MCA1 + 481.36 L4MCA2
     + 481.3888 L4MCA3 + 481.3888 L4NMC1 + 481.36 L4NMC2 + 481.3888 L4NMC3
     + 76.4193 L4GOS1 + 76.416 L4GOS2 + 76.4193 L4GOS3 <=   0

SRFGRER) - 74.16246 PS4WHE - 70.45434 PS4WHL - 24.48203 PS4BAR
     - 29.84561 PS4PUR - 864.6004 PS4HVA - 131.4217 PS4TOR
     - 154.0785 PS4NOR - 17466.97 PS4FDR - 406.8857 PS4FRU
     - 74.98103 PM4WHE - 71.23198 PM4WHL - 24.75225 PM4BAR
     - 30.17503 PM4PUR - 797.2962 PM4HVA - 101.0937 PM4TOR
     - 159.7008 PM4NOR - 16593.62 PM4FDR - 386.5414 PM4FRU
     - 77.92789 PL4WHE - 74.03149 PL4WHL - 25.72505 PL4BAR
     - 31.36095 PL4PUR - 641.9787 PL4HVA - 160.6266 PL4TOR
     - 155.2167 PL4NOR - 15720.27 PL4FDR - 366.1971 PL4FRU
     + 334.0155 L4MCA1 + 334 L4MCA2 + 334.0155 L4MCA3 + 334.0155 L4NMC1
     + 334 L4NMC2 + 334.0155 L4NMC3 + 53.02415 L4GOS1 + 53.02 L4GOS2
     + 53.02415 L4GOS3 <=   0

SRFPAST)   1.817 L4MCA1 + 1.817 L4MCA2 + 1.817 L4MCA3 + 1.817 L4NMC1
     + 1.817 L4NMC2 + 1.817 L4NMC3 + 1.036 L4GOS1 + 1.036 L4GOS2
     + 1.036 L4GOS3 <=   6097

SRFFISHM)   1.565 L4BRO1 + 1.957 L4BRO2 + 1.565 L4BRO3 + 1.633 L4BRO4
     + 1.565 L4LAY1 + 1.957 L4LAY2 + 1.565 L4LAY3 + 1.361 L4LAY4
     <=   18000
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SIND RICE ZONE HERD LEVELS

```
SRHLMCA)   L4MCA1 + L4MCA2 + L4MCA3 =    1105.999

SRHLNMCA)  L4NMC1 + L4NMC2 + L4NMC3 =    1914.003

SRHLGOSH)  L4GOS1 + L4GOS2 + L4GOS3 =    588

SRHLBRO)   L4BRO1 + L4BRO2 + L4BRO3 + L4BRO4 =    8629.998
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SRHLLAY) L4LAY1 + L4LAY2 + L4LAY3 + L4LAY4 = 2879.994

SRHLDESI) L4DESI = 4290

SIND COTTON ZONE
SMALL FARM RESOURCE RESTRICTIONS

SCSRFALK) 295.9896 PS5RIO + 305.1685 PS5COG + 403.8318 PS5CO3
+ 444.215 PS5CO4 + 1076.121 PS5SUG + 797.6753 PS5TOK + 357.8616 PS5NOK
+ 205.655 PS5PUK + 257.7376 PS5VEK + 1678.204 PS5FDK + 206.77 PS5FRU
<= 2129442

SCSRLAK) PS5RIO + PS5COG + PS5CO3 + PS5CO4 + PS5SUG + PS5TOK + PS5NOK
+ PS5PUK + PS5VEK + PS5FDK + PS5FRU <= 537

SCSRFALR) 184.6504 PS5WHE + 203.1155 PS5WHL + 187.3328 PS5BAR
+ 121.8203 PS5PUR + 231.0879 PS5HVA + 131.9514 PS5TOR
+ 357.8616 PS5NOR + 1678.204 PS5FDR + 206.77 PS5FRU <= 2129442

SCSRLAR) PS5SUG + PS5WHE + PS5WHL + PS5BAR + PS5PUR + PS5HVA + PS5TOR
+ PS5NOR + PS5FDR + PS5FRU <= 683

SCSROBCW) PS5CO4 + PS5WHE <= 683

SCSMKTSW) 2545.863 PS5WHE + 2418.57 PS5WHL + HS5WHE >= 423156

SCSMKTSR) 2069.345 PS5RIO + HS5RIC >= 153345

SIND COTTON ZONE
MEDIUM FARM RESOURCE RESTRICTIONS

SCMRFALK) 202.622 PM5RIO + 35.5824 PM5COG + 192.0214 PM5CO3
+ 211.2236 PM5CO4 + 1012.838 PM5SUG + 530.8911 PM5TOK
+ 255.0376 PM5NOK + 156.8139 PM5PUK + 166.428 PM5VEK + 1474.989 PM5FDK
+ 162.265 PM5FRU <= 587592

SCMRLAK) PM5RIO + PM5COG + PM5CO3 + PM5CO4 + PM5SUG + PM5TOK + PM5NOK
+ PM5PUK + PM5VEK + PM5FDK + PM5FRU <= 248

SCMRFALR) 137.7014 PM5WHE + 151.4716 PM5WHL + 176.4559 PM5BAR
+ 84.7553 PM5PUR + 137.3876 PM5HVA + 72.1532 PM5TOR + 255.0376 PM5NOR
+ 1474.989 PM5FDR + 162.265 PM5FRU <= 587592

SCMRLAR) PM5SUG + PM5WHE + PM5WHL + PM5BAR + PM5PUR + PM5HVA + PM5TOR
+ PM5NOR + PM5FDR + PM5FRU <= 260

SCMROBCW) PM5CO4 + PM5WHE <= 260

SCMMKTSW) 2573.963 PM5WHE + 2445.265 PM5WHL + HM5WHE >= 116765

SCMMKTSR) 2177.124 PM5RIO + HM5RIC >= 42314

SIND COTTON ZONE
LARGE FARM RESOURCE RESTRICTIONS

SCLRFALK) 85.0024 PL5RIO + 171.2897 PL5COG + 209.9325 PL5CO3
+ 230.9257 PL5CO4 + 554.27 PL5SUG + 158.4641 PL5TOK + 143.318 PL5NOK
+ 98.08881 PL5PUK + 68.1996 PL5VEK + 1101.671 PL5FDK + 40 PL5FRU
<= 338817

SCLRLAK) PL5RIO + PL5COG + PL5CO3 + PL5CO4 + PL5SUG + PL5TOK + PL5NOK
+ PL5PUK + PL5VEK + PL5FDK + PL5FRU <= 283

```
SCLRFALR)   89.53174 PL5WHE + 98.48491 PL5WHL + 157.6674 PL5BAR
     + 58.0685 PL5PUR + 149.4461 PL5HVA + 33.1114 PL5TOR + 143.318 PL5NOR
     + 1101.671 PL5FDR + 40 PL5FRU <=   338817


 SCLRLAR)   PL5SUG + PL5WHE + PL5WHL + PL5BAR + PL5PUR + PL5HVA + PL5TOR
     + PL5NOR + PL5FDR + PL5FRU <=   267

SCLROBCW)   PL5RIO + PL5CO4 + PL5WHE <=   267

SCLMKTSW)   2675.123 PL5WHE + 2541.367 PL5WHL + HL5WHE >=   67329

SCLMKTSR)   2166.346 PL5RIO + HL5RIC >=   24399
```

SIND COTTON ZONE
ZONAL RESOURCE RESTRICTIONS

```
 SCRFENK)   28.9 PS5RIO + 48.34 PS5COG + 63.19 PS5CO3 + 73.19 PS5CO4
     + 75.92 PS5SUG + 4.73 PS5TOK + 21.02 PS5NOK + 130.3 PS5VEK
     + 24.17 PS5FDK + 21.8 PS5FRU + 86.69 PM5COG + 75.7 PM5CO3
     + 87.7 PM5CO4 + 108.3 PM5SUG + 4.73 PM5TOK + 21.02 PM5NOK
     + 130.3 PM5VEK + 24.17 PM5FDK + 21.8 PM5FRU + 28.9 PL5RIO
     + 33.63 PL5COG + 88.76 PL5CO3 + 100.8 PL5CO4 + 154.5 PL5SUG
     + 4.73 PL5TOK + 21.02 PL5NOK + 130.3 PL5VEK + 24.17 PL5FDK
     + 21.8 PL5FRU - A5FENK <=   0

 SCRFEPK)   7.75 PS5RIO + 15.49 PS5COG + 27.99 PS5CO3 + 33.99 PS5CO4
     + 30.99 PS5SUG + 7.75 PS5TOK + 10.78 PS5NOK + 30.99 PS5VEK
     + 6.74 PS5FDK + 6.37 PS5FRU + 23.24 PM5COG + 26.67 PM5CO3
     + 30.67 PM5CO4 + 36.1 PM5SUG + 7.75 PM5TOK + 10.78 PM5NOK
     + 30.99 PM5VEK + 6.74 PM5FDK + 12.74 PM5FRU + 7.75 PL5RIO
     + 15.49 PL5COG + 28.38 PL5CO3 + 36.38 PL5CO4 + 15.49 PL5SUG
     + 7.75 PL5TOK + 10.78 PL5NOK + 30.99 PL5VEK + 6.74 PL5FDK
     + 6.37 PL5FRU - A5FEPK <=   0

 SCRFEKK)   27.79 PS5RIO + 5.58 PS5TOK + 55.58 PS5VEK + 8.89 PS5FDK
     + 5.58 PM5TOK + 55.58 PM5VEK + 8.89 PM5FDK + 27.79 PL5RIO
     + 5.58 PL5TOK + 8.89 PL5FDK - A5FEKK <=   0

 SLCFENK)   A5FENK <=   78326

 SLCFEPK)   A5FEPK <=   27704

 SLCFEKK)   A5FEKK <=   3015

 SCRBULK)   35.052 PS5RIO + 49.42 PS5COG + 73.35781 PS5CO3 + 80.69359 PS5CO4
     + 7.413 PS5SUG + 5.35465 PS5TOK + 37.62 PS5NOK + 48.10402 PS5PUK
     + 26.452 PS5VEK + 5.93 PS5FDK + 31.255 PS5FRU + 4.942 PM5RIO
     + 8.52495 PM5COG + 30.93939 PM5CO3 + 34.03333 PM5CO4 + 8.6485 PM5SUG
     + 2.67732 PM5TOK + 28.694 PM5NOK + 43.82001 PM5PUK + 13.226 PM5VEK
     + 2.965 PM5FDK + 21.8 PM5FRU + 7.413 PL5COG + 13.5905 PL5SUG
     + 19.768 PL5NOK + 39.536 PL5PUK <=   418500

 SCRFENR)   117.7 PS5WHE + 137.7 PS5WHL + 20.33 PS5BAR + 9.15 PS5PUR
     + 197.8 PS5HVA + 65.05 PS5TOR + 40.66 PS5NOR + 46.75 PS5FDR
     + 21.8 PS5FRU + 146.2 PM5WHE + 166.2 PM5WHL + 26.43 PM5BAR
     + 9.15 PM5PUR + 233.8 PM5HVA + 65.05 PM5TOR + 40.66 PM5NOR
     + 46.75 PM5FDR + 21.8 PM5FRU + 149.6 PL5WHE + 169.6 PL5WHL
     + 30.49 PL5BAR + 9.15 PL5PUR + 216.5 PL5HVA + 65.05 PL5TOR
     + 40.66 PL5NOR + 46.75 PL5FDR + 21.8 PL5FRU - A5FENR <=   0
```

```
SCRFEPR)   27.49 PS5WHE + 37.49 PS5WHL + 7.74 PS5PUR + 46.1 PS5HVA
    + 15.47 PS5TOR + 10.76 PS5NOR + 6.73 PS5FDR + 6.37 PS5FRU
    + 24.23 PM5WHE + 30.23 PM5WHL + 7.74 PM5PUR + 54.07 PM5HVA
    + 15.47 PM5TOR + 10.76 PM5NOR + 6.73 PM5FDR + 6.37 PM5FRU
    + 28.26 PL5WHE + 36.26 PL5WHL + 7.74 PL5PUR + 49.51 PL5HVA
    + 15.47 PL5TOR + 10.76 PL5NOR + 6.73 PL5FDR + 6.37 PL5FRU - A5FEPR
    <=   0

SCRFEKR)   0.57 PS5FDR + 12.31 PM5WHE + 16.31 PM5WHL + 0.57 PM5FDR
    + 8.18 PL5WHE + 6.16 PL5WHL + 21.47 PL5HVA + 0.57 PL5FDR - A5FEKR
    <=   0

SLCFENR)   A5FENR <=   130262.6

SLCFEPR)   A5FEPR <=   28902.96

SLCFEKR)   A5FEKR <=   3869

SCRBULR)   62.84247 PS5WHE + 59.70034 PS5WHL + 149.7558 PS5BAR
    + 58.5627 PS5PUR + 3.75592 PS5HVA + 21.2506 PS5TOR + 37.62 PS5NOR
    + 5.93 PS5FDR + 31.255 PS5FRU + 35.09067 PM5WHE + 33.33613 PM5WHL
    + 149.7558 PM5BAR + 49.6671 PM5PUR + 11.8608 PM5TOR + 28.694 PM5NOR
    + 2.965 PM5FDR + 16.125 PM5FRU + 149.7558 PL5BAR + 40.7715 PL5PUR
    + 2.471 PL5TOR + 19.768 PL5NOR <=   418500

 SCRFYM)   1.2355 PS5RIO + 19.768 PS5COG + 1.9 PS5CO3 + 2.09 PS5CO4
    + 44.478 PS5SUG + 37.065 PS5FDK + 19.0267 PS5WHE + 18.07536 PS5WHL
    + 37.065 PS5FDR + 14.36 PS5FRU + 30.68117 PM5CO3 + 33.74928 PM5CO4
    + 33.1114 PM5SUG + 37.065 PM5FDK + 31.25815 PM5WHE + 29.69524 PM5WHL
    + 37.065 PM5FDR + 14.36 PM5FRU + 7.413 PL5COG + 13.5905 PL5SUG
    + 19.768 PL5NOK + 39.536 PL5PUK + 37.56414 PL5WHE + 35.68593 PL5WHL
    + 29.652 PL5HVA + 37.065 PL5FDR + 14.36 PL5FRU <=   48990

SCRTOWK)   9.3898 PS5RIO + 4.73196 PS5COG + 4.81227 PS5CO3 + 5.2935 PS5CO4
    + 6.365 PS5SUG + 2.10035 PS5TOK + 3.77445 PS5NOK + 2.10035 PS5PUK
    + 6.79772 PS5VEK + 4.01537 PS5FDK + 6.215 PS5FRU + 10.5141 PM5RIO
    + 4.73196 PM5COG + 4.92964 PM5CO3 + 5.42261 PM5CO4 + 6.21 PM5SUG
    + 1.9768 PM5TOK + 3.77445 PM5NOK + 1.9768 PM5PUK + 6.79772 PM5VEK
    + 4.74432 PM5FDK + 6.215 PM5FRU + 9.3898 PL5RIO + 4.73196 PL5COG
    + 4.81227 PL5CO3 + 5.2935 PL5CO4 + 6.365 PL5SUG + 2.10035 PL5TOK
    + 3.77445 PL5NOK + 2.10035 PL5PUK + 6.79772 PL5VEK + 4.01537 PL5FDK
    + 6.215 PL5FRU - IB5CAK - IB5TUK <=   0

SCRTOWR)   6.365 PS5SUG + 4.32425 PS5WHE + 2.65632 PS5WHL + 4.73196 PS5BAR
    + 2.10035 PS5PUR + 4.32425 PS5HVA + 3.03933 PS5TOR + 3.77445 PS5NOR
    + 4.54664 PS5FDR + 6.215 PS5FRU + 6.21 PM5SUG + 2.31038 PM5WHE
    + 3.02697 PM5WHL + 4.73196 PM5BAR + 2.10035 PM5PUR + 4.32425 PM5HVA
    + 3.03933 PM5TOR + 3.77445 PM5NOR + 4.54664 PM5FDR + 6.215 PM5FRU
    + 6.365 PL5SUG + 4.32425 PL5WHE + 2.65632 PL5WHL + 4.73196 PL5BAR
    + 2.10035 PL5PUR + 4.32425 PL5HVA + 3.03933 PL5TOR + 3.77445 PL5NOR
    + 4.54664 PL5FDR + 6.215 PL5FRU - IB5CAR - IB5TUR <=   0

SCRCAWK)   IB5CAK <=   15652

SCRCAWR)   IB5CAR <=   6843

SCRTUWK)   IB5TUK <=   160

SCRTUWR)   IB5TUR <=   160
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SIND COTTON ZONE LIVESTOCK FEED RATIONS

```
SCFFEED) - 244.1745 PS5RIO - 205.0942 PS5COG - 73.64426 PS5CO3
    - 81.00869 PS5CO4 - 453.08 PS5SUG - 101.6584 PS5PUK - 84.59115 PS5VEK
    - 598.3837 PS5WHE - 568.4486 PS5WHL - 165.1969 PS5BAR
    - 195.0731 PS5PUR - 457.0025 PS5HVA - 256.8924 PM5RIO
    - 215.7591 PM5COG - 71.43493 PM5CO3 - 78.57843 PM5CO4 - 448.66 PM5SUG
    - 78.19489 PM5PUK - 65.07012 PM5VEK - 604.937 PM5WHE - 574.6848 PM5WHL
    - 167.0172 PM5BAR - 197.224 PM5PUR - 421.4274 PM5HVA - 255.6146 PL5RIO
    - 214.6978 PL5COG - 69.96205 PL5CO3 - 76.95825 PL5CO4 - 484.02 PL5SUG
    - 124.2498 PL5PUK - 103.3892 PL5VEK - 628.7201 PL5WHE
    - 597.2841 PL5WHL - 173.5913 PL5BAR - 204.9814 PL5PUR
    - 339.3312 PL5HVA + 340.2973 L5MCA1 + 374.3 L5MCA2 + 340.3 L5MCA3
    + 19.84989 L5NMC1 + 21.83 L5NMC2 + 19.85 L5NMC3 + 4.40185 L5GOS1
    + 4.842 L5GOS2 + 4.622 L5GOS3 + 10.47 L5BRO1 + 13.08139 L5BRO2
    + 12.55814 L5BRO3 + 10.92012 L5BRO4 + 10.46511 L5LAY1
    + 13.08139 L5LAY2 + 12.55814 L5LAY3 + 9.100099 L5LAY4 + 4.88888 L5DESI
    <=   0

SCFCAKE)   123.1542 L5MCA1 + 123.18 L5MCA2 + 135.48 L5MCA3 + 3.65882 L5NMC1
    + 3.6588 L5NMC2 + 4.0248 L5NMC3 + 0.323 L5BRO1 + 0.4038 L5BRO2
    + 0.38765 L5BRO3 + 0.33709 L5BRO4 + 0.32304 L5LAY1 + 0.4038 L5LAY2
    + 0.38765 L5LAY3 + 0.28091 L5LAY4 - DF5CAK <=   0

SCFSTRAW) - 2069.345 PS5RIO - 846.0873 PS5COG - 4530.784 PS5SUG
    - 1570.822 PS5TOK - 768.2019 PS5NOK - 423.5718 PS5PUK
    - 169.1823 PS5VEK - 3182.329 PS5WHE - 3023.213 PS5WHL
    - 740.1406 PS5BAR - 823.8071 PS5PUR - 739.8136 PS5TOR
    - 769.7272 PS5NOR - 2177.124 PM5RIO - 890.1543 PM5COG
    - 4486.582 PM5SUG - 1628.141 PM5TOK - 796.2335 PM5NOK
    - 325.8245 PM5PUK - 130.1403 PM5VEK - 3217.454 PM5WHE
    - 3056.581 PM5WHL - 748.3099 PM5BAR - 832.8999 PM5PUR
    - 569.0874 PM5TOR - 797.8144 PM5NOR - 2166.346 PL5RIO
    - 885.7476 PL5COG - 4840.204 PL5SUG - 1582.427 PL5TOK - 773.877 PL5NOK
    - 517.6989 PL5PUK - 206.7784 PL5VEK - 3343.904 PL5WHE
    - 3176.709 PL5WHL - 777.7194 PL5BAR - 865.6339 PL5PUR
    - 904.2166 PL5TOR - 775.4136 PL5NOR + 537.9841 L5MCA1 + 591.76 L5MCA2
    + 538 L5MCA3 + 537.9841 L5NMC1 + 591.76 L5NMC2 + 538 L5NMC3
    + 52.57817 L5GOS1 + 57.84 L5GOS2 + 55.208 L5GOS3 <=   0

SCFGREK) - 41.3869 PS5RIO - 11.28116 PS5COG - 22.65977 PS5CO3
    - 24.92575 PS5CO4 - 14951.59 PS5SUG - 157.0822 PS5TOK
    - 153.6404 PS5NOK - 42.35717 PS5PUK - 169.1823 PS5VEK - 27155 PS5FDK
    - 398.7437 PS5FRU - 43.54247 PM5RIO - 11.86872 PM5COG
    - 21.97998 PM5CO3 - 24.17797 PM5CO4 - 14805.72 PM5SUG
    - 162.8141 PM5TOK - 159.2467 PM5NOK - 32.58244 PM5PUK
    - 130.1403 PM5VEK - 378.8066 PM5FRU - 43.32691 PL5RIO
    - 11.80996 PL5COG - 21.52678 PL5CO3 - 23.67946 PL5CO4
    - 15972.67 PL5SUG - 158.2427 PL5TOK - 154.7754 PL5NOK
    - 51.76988 PL5PUK - 206.7784 PL5VEK - 358.8694 PL5FRU
    + 515.4592 L5MCA1 + 515.44 L5MCA2 + 515.4592 L5MCA3 + 515.4592 L5NMC1
    + 515.44 L5NMC2 + 515.4592 L5NMC3 + 50.37676 L5GOS1 + 50.376 L5GOS2
    + 50.37676 L5GOS3 <=   0

SCFGRER) - 127.2932 PS5WHE - 120.9285 PS5WHL - 29.60562 PS5BAR
    - 32.95228 PS5PUR - 914.0049 PS5HVA - 147.9627 PS5TOR
    - 153.9454 PS5NOR - 27155.48 PS5FDR - 398.7437 PS5FRU
    - 128.6982 PM5WHE - 122.2633 PM5WHL - 29.93239 PM5BAR
    - 33.31599 PM5PUR - 842.8548 PM5HVA - 113.8175 PM5TOR
    - 159.5629 PM5NOR - 25797.7 PM5FDR - 378.8066 PM5FRU - 133.7562 PL5WHE
    - 127.0684 PL5WHL - 31.10877 PL5BAR - 34.62535 PL5PUR
    - 678.6623 PL5HVA - 180.8433 PL5TOR - 155.0827 PL5NOR
```


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```
    - 24439.93 PL5FDR - 358.8694 PL5FRU + 497.7113 L5MCA1 + 497.7 L5MCA2
    + 497.7113 L5MCA3 + 497.7113 L5NMC1 + 497.7 L5NMC2 + 497.7113 L5NMC3
    + 48.64222 L5GOS1 + 48.64 L5GOS2 + 48.64222 L5GOS3 <=   0

 SCFPAST)   2.159 L5MCA1 + 2.159 L5MCA2 + 2.159 L5MCA3 + 2.159 L5NMC1
    + 2.159 L5NMC2 + 2.159 L5NMC3 + 0.758 L5GOS1 + 0.758 L5GOS2
    + 0.758 L5GOS3 <=   10968

SCFFISHM)   0.6279 L5BRO1 + 0.7849 L5BRO2 + 0.6279 L5BRO3 + 0.6552 L5BRO4
    + 0.6279 L5LAY1 + 0.7849 L5LAY2 + 0.6279 L5LAY3 + 0.546 L5LAY4
    <=   9450
```

SIND COTTON ZONE HERD LEVELS

```
 SCHLMCA)   L5MCA1 + L5MCA2 + L5MCA3 =    1683.994

SCHLNMCA)   L5NMC1 + L5NMC2 + L5NMC3 =    2888.002

SCHLGOSH)   L5GOS1 + L5GOS2 + L5GOS3 =    1447.004

 SCHLBRO)   L4BRO1 + L5BRO2 + L5BRO3 + L5BRO4 =    4519.996

 SCHLLAY)   L5LAY1 + L5LAY2 + L5LAY3 + L5LAY4 =    1510.002

SCHLDESI)   L5DESI =    2250.001
```

BALUCHISTAN PRODUCTION ROWS

```
 BAPRIB) - 1530.2 PS6RIB - 1610 PM6RIB - 1601.6 PL6RIB + MBARIB <=   0

 BAPRIO) - 3553.48 PS6RIO - 3738.7 PM6RIO - 3720.08 PL6RIO + MBARIO <=   0

 BAPCOG) - 408.184 PS6COG - 755.565 PS6BAR - 517.556 PM6COG
    - 763.895 PM6BAR - 512.894 PL6COG - 793.9 PL6BAR + MBACOG <=   0

 BAPSUG) - 54054 PS6SUG - 54054 PM6SUG - 54054 PL6SUG + MBASUG <=   0

 BAPTOL) - 396.4085 PS6TOK - 650.6841 PS6TOR - 304.9296 PM6TOK
    - 500.5262 PM6TOR - 484.4992 PL6TOK - 795.2805 PL6TOR + MBATOL
    <=   0

 BAPPUL) - 507.775 PS6PUK - 458.568 PS6PUR - 390.545 PM6PUK
    - 463.672 PM6PUR - 620.54 PL6PUK - 481.888 PL6PUR + MBAPUL <=   0

 BAPVEG) - 13800.66 PS6VEK - 14236.43 PS6HVA - 12726.35 PM6VEK
    - 13128.2 PM6HVA - 10247.2 PL6VEK - 10570.76 PL6HVA + MBAVEG + MXBVEG
    <=   0

 BAPWHE) - 1750.5 PS6WHE - 1925.1 PS6WHL - 1769.4 PM6WHE - 1946.7 PM6WHL
    - 1838.7 PL6WHE - 1746.9 PL6WHL + MBAWHE <=   0

 BAPFRU) - 12959.72 PS6FRU - 12833 PM6FRU - 13844.78 PL6FRU + MBAFRU
    + MXBFRU <=   0

 BAPMCA) - 1075 L6MCA1 - 1183 L6MCA2 - 1129 L6MCA3 + MBAMCA + MBABUT
    + MBAAGE <=   0

 BAPNMC) - 167 L6NMC1 - 183.7 L6NMC2 - 175.4 L6NMC3 + MBANMC <=   0

 BAPGOS) - 164 L6GOS1 - 180.4 L6GOS2 - 172.2 L6GOS3 + MBAGOS <=   0
```

```
BAPPOU) - 0.909 L6BRO1 - 0.909 L6BRO2 - 1.092 L6BRO3 - 0.909 L6BRO4
   - 1.364 L6LAY1 - 1.364 L6LAY2 - 1.638 L6LAY3 - 1.364 L6LAY4
   - 1.136 L6DESI + MBAPOU <=   0

BAPEGG) - 133 L6LAY1 - 133 L6LAY2 - 160 L6LAY3 - 133 L6LAY4 - 89 L6DESI
   + MBAEGG <=   0
```

BALUCHISTAN INPUT BALANCES

```
BAIFEN)   A6FENK + A6FENR - IBAFEN <=   0

BAIFEP)   A6FEPK + A6FEPR - IBAFEP <=   0

BAIFEK)   A6FEKK + A6FEKR - IBAFEK <=   0

 BAIHL)   ABAHLK + ABAHLR - IBAHL <=   0

BAITTR)   6.88524 PS6RIB + 9.978 PS6RIO + 0.44478 PS6COG + 1.53886 PS6TOK
   + 2.33337 PS6PUK + 7.602 PS6VEK + 2.373 PS6FDK + 7.83235 PS6WHE
   + 7.44073 PS6WHL + 5.34024 PS6BAR + 2.376 PS6PUR + 10.3782 PS6HVA
   + 6.30105 PS6TOR + 2.373 PS6FDR + 22.82 PS6FRU + 5.6833 PM6RIB
   + 8.52495 PM6RIO + 1.53202 PM6COG + 14.826 PM6SUG + 2.05182 PM6TOK
   + 3.11116 PM6PUK + 10.136 PM6VEK + 3.164 PM6FDK + 3.0096 PM6WHE
   + 2.85912 PM6WHL + 2.376 PM6BAR   3.168 PM6PUR + 13.8376 PM6HVA
   + 8.4014 PM6TOR + 3.164 PM6FDR + 45.65 PM6FRU + 5.21381 PL6RIB
   + 16.63 PL6RIO + 2.69339 PL6COG + 23.69689 PL6SUG + 2.56477 PL6TOK
   + 3.88895 PL6PUK + 12.67 PL6VEK + 3.955 PL6FDK + 4.356 PL6WHE
   + 3.5739 PL6WHL + 2.97 PL6BAR + 3.96 PL6PUR + 17.297 PL6HVA
   + 10.50175 PL6TOR + 3.955 PL6FDR + 91.29 PL6FRU - IBATTR <=   0
```

BALUCHISTAN REGIONAL RESOURCE RESTRICTIONS

```
BARFENK)   19.83631 PS6RIB + 23.08226 PS6RIO + 11.18047 PS6COG
   + 13.68345 PS6SUG + 3.24594 PS6TOK + 89.44376 PS6VEK + 8.29518 PS6FDK
   + 53.92 PS6FRU + 19.83631 PM6RIB + 23.08226 PM6RIO + 12.00277 PM6COG
   + 31.37745 PM6SUG + 3.24594 PM6TOK + 89.44376 PM6VEK + 8.29518 PM6FDK
   + 53.92 PM6FRU + 19.83631 PL6RIB + 28.85282 PL6RIO + 15.41462 PL6COG
   + 27.94396 PL6SUG + 3.24594 PL6TOK + 89.44376 PL6VEK + 8.3 PL6FDK
   + 53.92 PL6FRU - A6FENK <=   0

BARFEPK)   8.40888 PS6RIB + 16.81777 PS6RIO + 4.31412 PS6COG
   + 13.95875 PS6SUG + 8.40888 PS6TOK + 33.63555 PS6VEK + 7.31207 PS6FDK
   + 21.03 PS6FRU + 8.40888 PM6RIB + 16.81777 PM6RIO + 0.99444 PM6COG
   + 16.81777 PM6SUG + 8.40888 PM6TOK + 33.63555 PM6VEK + 7.31207 PM6FDK
   + 21.03 PM6FRU + 8.40888 PL6RIB + 4.98683 PL6COG + 26.40391 PL6SUG
   + 8.40888 PL6TOK + 33.63555 PL6VEK + 7.31 PL6FDK + 21.03 PL6FRU
   - A6FEPK <=   0

BARFEKK)   1.75999 PS6SUG + 1.09999 PS6TOK + 1.09999 PS6VEK + 0.176 PS6FDK
   + 2.2 PS6FRU + 4.39999 PM6SUG + 1.09999 PM6TOK + 1.09999 PM6VEK
   + 0.176 PM6FDK + 2.2 PM6FRU + 2.63999 PL6SUG + 1.09999 PL6TOK
   + 0.176 PL6FDK + 2.2 PL6FRU - A6FEKK <=   0

BLAFENK)   A6FENK <=   6930

BLAFEPK)   A6FEPK <=   2660

BLAFEKK)   A6FEKK <=   70

BARBULK)   25.9174 PS6RIB + 35.052 PS6RIO + 116.0135 PS6COG
   + 65.4815 PS6SUG + 5.35465 PS6TOK + 48.10402 PS6PUK + 26.452 PS6VEK
   + 5.93 PS6FDK + 266.25 PS6FRU + 110.5526 PM6RIB + 4.942 PM6RIO
```

```
    + 95.00995 PM6COG + 17.297 PM6SUG + 2.67732 PM6TOK + 43.82001 PM6PUK
    + 13.226 PM6VEK + 2.965 PM6FDK + 236.465 PM6FRU + 46.25712 PL6RIB
    + 31.97474 PL6COG + 74.13 PL6SUG + 39.536 PL6PUK + 177.035 PL6FRU
    <=   87500

BARFENR)   12.08007 PS6WHE + 13.28808 PS6WHL + 45.56345 PS6HVA
    + 16.75897 PS6TOR + 38.77 PS6FRU + 12.08007 PM6WHE + 13.28808 PM6WHL
    + 8.37948 PM6PUR + 45.56345 PM6HVA + 16.75897 PM6TOR + 38.77 PM6FRU
    + 12.08007 PL6WHE + 13.28808 PL6WHL + 8.37948 PL6PUR + 45.56345 PL6HVA
    + 16.75897 PL6TOR + 38.77 PL6FRU - A6FENR <=   0

BARFEPR)   5.89675 PS6WHE + 6.48642 PS6WHL + 11.75976 PS6HVA
    + 5.87988 PS6TOR + 2.55647 PS6FDR + 7.36 PS6FRU + 5.89675 PM6WHE
    + 6.48642 PM6WHL + 2.93994 PM6PUR + 11.75976 PM6HVA + 5.87988 PM6TOR
    + 2.55647 PM6FDR + 7.36 PM6FRU + 5.89675 PL6WHE + 6.48642 PL6WHL
    + 2.93994 PL6PUR + 11.75976 PL6HVA + 5.87988 PL6TOR + 2.55647 PL6FDR
    + 7.36 PL6FRU - A6FEPR <=   0

BARFEKR)   3.28007 PS6HVA + 0.1312 PS6FDR + 1.68 PS6FRU + 3.28007 PM6HVA
    + 0.1312 PM6FDR + 1.68 PM6FRU + 3.28007 PL6HVA + 0.1312 PL6FDR
    + 1.68 PL6FRU - A6FEKR <=   0

BLAFENR)   A6FENR <=   4910

BLAFEPR)   A6FEPR <=   1860

BLAFEKR)   A6FEKR <=   140

BARBULR)   48.136 PS6PUR + 29.652 PS6HVA + 21.2506 PS6TOR + 5.93 PS6FDR
    + 266.25 PS6FRU + 43.836 PM6PUR + 14.826 PM6HVA + 11.8608 PM6TOR
    + 2.965 PM6FDR + 236.465 PM6FRU + 39.536 PL6PUR + 2.471 PL6TOR
    + 177.035 PL6FRU <=   87500

 BARFYM)   25.9174 PS6RIB + 35.052 PS6RIO + 116.0135 PS6COG
    + 65.4815 PS6SUG + 5.35465 PS6TOK + 48.10402 PS6PUK + 26.452 PS6VEK
    + 5.93 PS6FDK + 5.4362 PS6WHE + 5.16439 PS6WHL + 4.942 PS6BAR
    + 4.942 PS6PUR + 148.26 PS6HVA + 37.065 PS6FDR + 81.07 PS6FRU
    + 110.5526 PM6RIB + 4.942 PM6RIO + 95.00995 PM6COG + 17.297 PM6SUG
    + 2.67732 PM6TOK + 43.82001 PM6PUK + 13.226 PM6VEK + 2.965 PM6FDK
    + 5.4362 PM6WHE + 5.16439 PM6WHL + 4.942 PM6BAR + 4.942 PM6PUR
    + 148.26 PM6HVA + 37.065 PM6FDR + 81.07 PM6FRU + 46.25712 PL6RIB
    + 31.97474 PL6COG + 74.13 PL6SUG + 39.536 PL6PUK + 5.4362 PL6WHE
    + 5.16439 PL6WHL + 4.942 PL6BAR + 4.942 PL6PUR + 148.26 PL6HVA
    + 37.065 PL6FDR + 81.07 PL6FRU <=   53240

BARTOWK)   8.74734 PS6RIB + 8.327269 PS6RIO + 3.08875 PS6COG + 4.744 PS6SUG
    + 1.35905 PS6TOK + 1.35905 PS6PUK + 8.85606 PS6VEK + 2.84165 PS6FDK
    + 8.74734 PM6RIB + 8.327269 PM6RIO + 3.08875 PM6COG + 4.745 PM6SUG
    + 1.35905 PM6TOK + 1.35905 PM6PUK + 8.85606 PM6VEK + 2.84165 PM6FDK
    + 5.745 PM6FRU + 8.74734 PL6RIB + 8.327269 PL6RIO + 3.08875 PL6COG
    + 4.745 PL6SUG + 1.35905 PL6TOK + 1.35905 PL6PUK + 8.85606 PL6VEK
    + 2.84165 PL6FDK - IB6CAK - IB6TUK <=   0

BARTOWR)   4.745 PS6SUG + 3.68179 PS6WHE + 3.65708 PS6WHL + 3.08875 PS6BAR
    + 1.35905 PS6PUR + 3.7065 PS6HVA + 2.84165 PS6TOR + 5.4362 PS6FDR
    + 5.745 PS6FRU + 4.744 PM6SUG + 3.68179 PM6WHE + 2.64397 PM6WHL
    + 3.08875 PM6BAR + 1.35905 PM6PUR + 3.7065 PM6HVA + 2.84165 PM6TOR
    + 5.4362 PM6FDR + 5.745 PM6FRU + 4.745 PL6SUG + 3.68179 PL6WHE
    + 2.64397 PL6WHL + 3.08875 PL6BAR + 1.35905 PL6PUR + 3.7065 PL6HVA
    + 2.84165 PL6TOR + 5.4362 PL6FDR + 5.745 PL6FRU - IB6CAR - IB6TUR
    <=   0
```

```
BARCAWK)   5.745 PS6FRU + 5.745 PL6FRU + IB6CAK <=   738

BARCAWR)   IB6CAR <=   1185

BARTUWK)   IB6TUK <=   555

BARTUWR)   IB6TUR <=   555

BARHLK)   79.072 PS6RIB + 100.8168 PS6RIO + 264.1069 PS6TOK
    + 75.1184 PS6PUK + 193.7264 PS6VEK + 181.9645 PS6FDK + 188.66 PS6FRU
    + 118.608 PM6RIB + 153.202 PM6RIO + 528.2138 PM6TOK + 119.6755 PM6PUK
    + 271.81 PM6VEK + 382.2143 PM6FDK + 440.21 PM6FRU + 164.5686 PL6RIB
    + 212.506 PL6RIO + 112.9494 PL6SUG + 897.9634 PL6TOK + 174.1166 PL6PUK
    + 356.8124 PL6VEK + 752.5678 PL6FDK + 565.985 PL6FRU - ABAHLK
    <=   0

BARHLR)   116.5521 PS6WHE + 110.7245 PS6WHL + 79.46736 PS6BAR
    + 35.5824 PS6PUR + 268.8448 PS6HVA + 27.6752 PS6TOR + 181.9645 PS6FDR
    + 188.66 PS6FRU + 186.5704 PM6WHE + 177.2419 PM6WHL + 127.2071 PM6BAR
    + 441.8148 PM6HVA + 60.2924 PM6TOR + 382.2143 PM6FDR + 440.21 PM6FRU
    + 267.461 PL6WHE + 254.088 PL6WHL + 182.3598 PL6BAR + 601.9356 PL6HVA
    + 87.9676 PL6TOR + 752.5678 PL6FDR + 565.985 PL6FRU - ABAHLR <=   0

BLAHLK)   ABAHLK <=   84341

BLAHLR)   ABAHLR <=   84341
```

BALUCHISTAN
SMALL FARM RESOURCE RESTRICTIONS

```
BASRFALK)   176.6484 PS6RIB + 205.0568 PS6RIO + 166.5948 PS6COG
    + 1435.972 PS6SUG + 797.6753 PS6TOK + 205.655 PS6PUK + 257.7376 PS6VEK
    + 1678.204 PS6FDK + 706.23 PS6FRU <=   340617

BASRLAK)   PS6RIB + PS6RIO + PS6COG + PS6SUG + PS6TOK + PS6PUK + PS6VEK
    + PS6FDK + PS6FRU <=   67

BASRFALR)   184.7913 PS6WHE + 203.2704 PS6WHL + 145.8878 PS6BAR
    + 96.5676 PS6PUR + 482.3392 PS6HVA + 131.9514 PS6TOR + 1678.204 PS6FDR
    + 706.23 PS6FRU <=   340617

BASRLAR)   PS6SUG + PS6WHE + PS6WHL + PS6BAR + PS6PUR + PS6HVA + PS6TOR
    + PS6FDR + PS6FRU <=   78

BASROBCW)   PS6RIB + PS6WHE <=   78

BASMKTSW)   2288 PS6WHE + 2516.8 PS6WHL + HS6WHE >=   156713

BASMKTSR)   2478.638 PS6RIB + 4029.021 PS6RIO + HS6RIC >=   18800

BAMRFALK)   203.9564 PM6RIB + 120.5848 PM6RIO + 151.9418 PM6COG
    + 1478.276 PM6SUG + 530.8911 PM6TOK + 156.8139 PM6PUK + 166.428 PM6VEK
    + 1474.989 PM6FDK + 425.125 PM6FRU <=   107042

BAMRLAK)   PM6RIB + PM6RIO + PM6COG + PM6SUG + PM6TOK + PM6PUK + PM6VEK
    + PM6FDK + PM6FRU <=   35
```

BALUCHISTAN
MEDIUM FARM RESOURCE RESTRICTIONS

```
BAMRFALR)   115.8701 PM6WHE + 127.4571 PM6WHL + 91.47642 PM6BAR
    + 228.2714 PM6PUR + 294.5432 PM6HVA + 72.1532 PM6TOR + 1474.989 PM6FDR
```

```
     + 425.125 PM6FRU <=   107042

 BAMRLAR)   PM6SUG + PM6WHE + PM6WHL + PM6BAR + PM6PUR + PM6HVA + PM6TOR
     + PM6FDR + PM6FRU <=   72

BAMROBCW)   PM6RIB + PM6WHE <=   72

BAMMKTSW)   2313.3 PM6WHE + 2544.63 PM6WHL + HM6WHE >=   49248

BAMMKTSR)   2607.734 PM6RIB + 4238.865 PM6RIO + HM6RIC >=   5908
```

BALUCHISTAN
LARGE FARM RESOURCE RESTRICTIONS

```
BALRFALK)   91.72352 PL6RIB + 54.362 PL6RIO + 80.70286 PL6COG
     + 1411.584 PL6SUG + 158.4641 PL6TOK + 98.08881 PL6PUK + 68.1996 PL6VEK
     + 1101.671 PL6FDK + 240.235 PL6FRU <=   123560

 BALRLAK)   PL6RIB + PL6RIO + PL6COG + PL6SUG + PL6TOK + PL6PUK + PL6VEK
     + PL6FDK + PL6FRU <=   106


BALRFALR)   45.07104 PL6WHE + 57.40627 PL6WHL + 35.5824 PL6BAR
     + 223.9714 PL6PUR + 119.5964 PL6HVA + 33.1114 PL6TOR + 1101.671 PL6FDR
     + 240.235 PL6FRU <=   123560

 BALRLAR)   PL6SUG + PL6WHE + PL6WHL + PL6BAR + PL6PUR + PL6HVA + PL6TOR
     + PL6FDR + PL6FRU <=   152

BALROBCW)   PL6RIB + PL6WHE <=   152

BALMKTSW)   2403.5 PL6WHE + 2283.325 PL6WHL + HL6WHE >=   56849

BALMKTSR)   2594.824 PL6RIB + 4217.881 PL6RIO + HL6RIC >=   6820
```

BALUCHISTAN LIVESTOCK FEED RATIONS

```
 BAFFEED) - 292.4838 PS6RIB - 475.422 PS6RIO - 233.208 PS6COG - 546 PS6SUG
     - 160.3381 PS6PUK - 726.3502 PS6VEK - 537.6585 PS6WHE
     - 539.9005 PS6WHL - 288.3701 PS6BAR - 192.8159 PS6PUR
     - 749.2856 PS6HVA - 307.7134 PM6RIB - 500.1865 PM6RIO
     - 295.7013 PM6COG - 546 PM6SUG - 123.3343 PM6PUK - 669.808 PM6VEK
     - 543.546 PM6WHE - 545.8988 PM6WHL - 291.5513 PM6BAR - 194.95 PM6PUR
     - 690.958 PM6HVA - 306.1824 PL6RIB - 497.7081 PL6RIO - 293.0282 PL6COG
     - 546 PL6SUG - 195.9649 PL6PUK - 539.3259 PL6VEK - 564.8815 PL6WHE
     - 536.6524 PL6WHL - 303.0066 PL6BAR - 202.6108 PL6PUR
     - 556.3557 PL6HVA + 170.6655 L6MCA1 + 187.7 L6MCA2 + 170.7 L6MCA3
     + 19.07832 L6NMC1 + 20.99 L6NMC2 + 19.08 L6NMC3 + 2.38239 L6GOS1
     + 2.621 L6GOS2 + 2.502 L6GOS3 + 10.12861 L6BRO1 + 12.66077 L6BRO2
     + 12.15434 L6BRO3 + 10.56899 L6BRO4 + 10.12861 L6LAY1
     + 12.66077 L6LAY2 + 12.15434 L6LAY3 + 8.80749 L6LAY4 + 5 L6DESI
     <=   0

 BAFCAKE)   136.838 L6MCA1 + 136.8 L6MCA2 + 150.56 L6MCA3 + 4.87843 L6NMC1
     + 4.8784 L6NMC2 + 5.3664 L6NMC3 + 0.43072 L6BRO1 + 0.53841 L6BRO2
     + 0.51687 L6BRO3 + 0.44945 L6BRO4 + 0.43072 L6LAY1 + 0.53841 L6LAY2
     + 0.51687 L6LAY3 + 0.37454 L6LAY4 - DF6CAK <=   0

BAFSTRAW) - 3717.957 PS6RIB - 4029.021 PS6RIO - 962.0573 PS6COG
     - 5460 PS6SUG - 396.4085 PS6TOK - 668.0657 PS6PUK - 1452.701 PS6VEK
     - 2859.654 PS6WHE - 2716.671 PS6WHL - 1291.959 PS6BAR
```

- 814.2747 PS6PUR - 813.3551 PS6TOR - 3911.601 PM6RIB
- 4238.865 PM6RIO - 1219.9 PM6COG - 17884 PM6SUG - 304.9296 PM6TOK
- 513.8967 PM6PUK - 1339.616 PM6VEK - 2891.217 PM6WHE
- 2746.656 PM6WHL - 1306.219 PM6BAR - 823.2622 PM6PUR
- 625.6578 PM6TOR - 3892.237 PL6RIB - 4217.881 PL6RIO - 1208.81 PL6COG
- 18676 PL6SUG - 484.4992 PL6TOK - 816.5247 PL6PUK - 1078.652 PL6VEK
- 3004.846 PL6WHE - 2854.604 PL6WHL - 1357.555 PL6BAR
- 855.6175 PL6PUR - 994.1007 PL6TOR + 628.8127 L6MCA1 + 691.68 L6MCA2
+ 628.8 L6MCA3 + 628.8127 L6NMC1 + 691.68 L6NMC2 + 628.8 L6NMC3
+ 46.29006 L6GOS1 + 50.92 L6GOS2 + 48.608 L6GOS3 <= 0

BAFGREK) - 49.57276 PS6RIB - 80.5804 PS6RIO - 12.82743 PS6COG
- 18018 PS6SUG - 39.64084 PS6TOK - 66.80656 PS6PUK - 1452.701 PS6VEK
- 3307.735 PS6FDK - 647.9859 PS6FRU - 52.15467 PM6RIB - 84.7773 PM6RIO
- 16.26533 PM6COG - 5419 PM6SUG - 30.49296 PM6TOK - 51.38966 PM6PUK
- 1339.616 PM6VEK - 3142.348 PM6FDK - 641.6641 PM6FRU
- 51.89648 PL6RIB - 84.35761 PL6RIO - 16.11746 PL6COG - 5659 PL6SUG
- 48.44992 PL6TOK - 81.65246 PL6PUK - 1078.652 PL6VEK
- 2976.962 PL6FDK - 692.2387 PL6FRU + 58.31279 L6MCA1 + 58.312 L6MCA2
+ 58.31279 L6MCA3 + 58.31279 L6NMC1 + 58.312 L6NMC2 + 58.31279 L6NMC3
+ 4.29269 L6GOS1 + 4.2928 L6GOS2 + 4.29269 L6GOS3 <= 0

BAFGRER) - 114.3861 PS6WHE - 108.6668 PS6WHL - 51.67836 PS6BAR
- 32.57098 PS6PUR - 1498.571 PS6HVA - 162.671 PS6TOR - 3307.735 PS6FDR
- 647.9859 PS6FRU - 115.6487 PM6WHE - 109.8663 PM6WHL
- 52.24876 PM6BAR - 32.93048 PM6PUR - 1381.916 PM6HVA
- 125.1316 PM6TOR - 3142.348 PM6FDR - 641.6641 PM6FRU
- 120.1938 PL6WHE - 114.1841 PL6WHL - 54.3022 PL6BAR - 34.2247 PL6PUR
- 1112.712 PL6HVA - 198.8201 PL6TOR - 2976.962 PL6FDR
- 692.2387 PL6FRU + 41.44525 L6MCA1 + 41.44 L6MCA2 + 41.44525 L6MCA3
+ 41.44525 L6NMC1 + 41.44 L6NMC2 + 41.44525 L6NMC3 + 3.05099 L6GOS1
+ 3.051 L6GOS2 + 3.05099 L6GOS3 <= 0

BAFPAST) 0.5242999 L6MCA1 + 524.3 L6MCA2 + 0.5242999 L6MCA3
+ 0.5242999 L6NMC1 + 0.5242999 L6NMC2 + 0.5242999 L6NMC3
+ 0.1387 L6GOS1 + 0.1387 L6GOS2 + 0.1387 L6GOS3 <= 651

BAFFISHM) 1.527 L6BRO1 + 1.909 L6BRO2 + 1.527 L6BRO3 + 1.594 L6BRO4
+ 1.527 L6LAY1 + 1.909 L6LAY2 + 1.527 L6LAY3 + 1.328 L6LAY4
<= 9484

BALUCHISTAN HERD LEVELS

BAHLMCA) L6MCA1 + L6MCA2 + L6MCA3 = 589

BAHLNMCA) L6NMC1 + L6NMC2 + L6NMC3 = 527

BAHLGOSH) L6GOS1 + L6GOS2 + L6GOS3 = 468.999

BAHLBRO) L6BRO1 + L6BRO2 + L6BRO3 + L6BRO4 = 4649.996

BAHLLAY) L6LAY1 + L6LAY2 + L6LAY3 + L6LAY4 = 1560

BAHLDESI) L6DESI = 2200.003

NWFP PRODUCTION ROWS

NPPRIB) - 1042.72 PS7RIB - 1451.38 PS8RIB - 1094.66 PM7RIB
- 1526.84 PM8RIB - 1094.66 PL7RIB - 1519 PL8RIB + MNPRIB <= 0

NPPRIO) - 3965.08 PS7RIO - 2167.76 PS8RIO - 4164.02 PM7RIO
- 2276.54 PM8RIO - 4164.02 PL7RIO - 2276.54 PL8RIO + MNPRIO <= 0

```
NPPCOG) - 1683.5 PS7COG - 711.28 PS7BAR - 705.738 PS8COG - 570.35 PS8BAR
   - 1767.12 PM7COG - 719.27 PM7BAR - 740.74 PM8COG - 576.725 PM8BAR
   - 1750.84 PL7COG - 747.065 PL7BAR - 733.784 PL8COG - 599.42 PL8BAR
   + MNPCOG <=   0

NPPCOT) - 199.9 PS7COT - 31.77 PS8COT - 197.8 PM7COT - 31.77 PM8COT
   - 213.8 PL7COT - 33.86 PL8COT + MNPCOT <=   0

NPPSUG) - 41345.37 PS7SUG - 30207.87 PS8SUG - 42999.66 PM7SUG
   - 31416.66 PM8SUG - 41759.19 PL7SUG - 30510.81 PL8SUG + MNPSUG
   <=   0

NPPTOL) - 1253 PS7TOK - 1235 PS7TOR - 572 PS8TOK - 493 PS8TOR
   - 1303 PM7TOK - 1136 PM7TOR - 595 PM8TOK - 453 PM8TOR - 1265 PL7TOK
   - 914 PL7TOR - 578 PL8TOK - 364 PL8TOR + MNPTOL <=   0

NPPNOK) - 683 PS7NOK - 1083.291 PS8NOK - 649 PM7NOK - 833.41 PM8NOK
   - 614 PL7NOK - 1324.346 PL8NOK + MNPNOK <=   0

NPPPUL) - 764.8 PS7PUK - 208.68 PS7PUR - 138 PS8PUK - 114.04 PS8PUR
   - 589.2 PM7PUK - 210.84 PM7PUR - 106.4 PM8PUK - 115.44 PM8PUR
   - 932.8 PL7PUK - 219.08 PL7PUR - 168.4 PL8PUK - 119.96 PL8PUR + MNPPUL
   <=   0

NPPVEG) - 17238.7 PS7VEK - 2276.2 PS7HVA - 14585.35 PS8VEK
   - 6839.05 PS8HVA - 13273.4 PM7VEK - 2093.8 PM7HVA - 11230.9 PM8VEK
   - 6291.85 PM8HVA - 15859.3 PL7VEK - 1684.35 PL7HVA - 13417.8 PL8VEK
   - 5060.65 PL8HVA + MNPVEG + MXNVEG <=   0

NPPWHE) - 1269 PS7WHE - 1038.6 PS7WHL - 731.25 PS8WHE - 598.32 PS8WHL
   - 1283.4 PM7WHE - 1050.3 PM7WHL - 738.81 PM8WHE - 604.53 PM8WHL
   - 1333.8 PL7WHE - 1091.7 PL7WHL - 768.24 PL8WHE - 628.56 PL8WHL
   + MNPWHE <=   0

NPPNOR) - 540 PS7NOR - 521 PS8NOR - 513 PM7NOR - 495 PM8NOR - 486 PL7NOR
   - 469 PL8NOR + MNPNOR <=   0

NPPFRU) - 10249 PS7FRU - 10901 PS8FRU - 10761 PM7FRU - 11446 PM8FRU
   - 10659 PL7FRU - 11337 PL8FRU + MNPFRU + MXNFRU <=   0

NPPMCA) - 1075 L7MCA1 - 1183 L7MCA2 - 1129 L7MCA3 - 1075 L8MCA1
   - 1183 L8MCA2 - 1129 L8MCA3 + MNPMCA + MNPBUT + MNPAGE <=   0

NPPNMC) - 167 L7NMC1 - 183.7 L7NMC2 - 175.4 L7NMC3 - 167 L8NMC1
   - 183.7 L8NMC2 - 175.4 L8NMC3 + MNPNMC <=   0

NPPGOS) - 164 L7GOS1 - 180.4 L7GOS2 - 172.2 L7GOS3 - 164 L8GOS1
   - 98.89 L8GOS2 - 172.2 L8GOS3 - 1.136 L8DESI + MNPGOS <=   0

NPPPOU) - 0.909 L7BRO1 - 0.909 L7BRO2 - 1.092 L7BRO3 - 0.909 L7BRO4
   - 1.364 L7LAY1 - 1.364 L7LAY2 - 1.638 L7LAY3 - 1.364 L7LAY4
   - 1.136 L7DESI - 0.909 L8BRO1 - 0.909 L8BRO2 - 1.092 L8BRO3
   - 0.909 L8BRO4 - 1.364 L8LAY1 - 1.364 L8LAY2 - 1.638 L8LAY3
   - 1.364 L8LAY4 - 1.136 L8DESI + MNPPOU <=   0

NPPEGG) - 133 L7LAY1 - 133 L7LAY2 - 160 L7LAY3 - 133 L7LAY4 - 89 L7DESI
   - 133 L8LAY1 - 133 L8LAY2 - 160 L8LAY3 - 133 L8LAY4 - 89 L8DESI
   + MNPEGG <=   0
```


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NWFP INPUT BALANCES

```
NPIFEN)   A7FENK + A7FENR - INPFEN <=   0

NPIFEP)   A7FEPK + A7FEPR - INPFEP <=   0

NPIFEK)   A7FEKK + A7FEKR - INPFEK <=   0

 NPIHL)   ANPHLK + ANPHLR - INPHL <=   0

NPITTR)   1.425 PS7COG + 6.651 PS7COT + 8.55 PS7SUG + 1.53886 PS7TOK
   + 5.226 PS7NOK + 2.33337 PS7PUK + 7.602 PS7VEK + 2.376 PS7FDK
   + 19.70622 PS7WHE + 18.72091 PS7WHL + 3.11809 PS7BAR + 5.6833 PS7PUR
   + 10.3782 PS7HVA + 6.30105 PS7TOR + 5.226 PS7NOR + 3.4594 PS7FDR
   + 22.82 PS7FRU + 9.59304 PS8RIB + 9.978 PS8RIO + 2.85 PS8COG
   + 6.651 PS8COT + 8.55 PS8SUG + 1.53886 PS8TOK + 5.226 PS8NOK
   + 2.33337 PS8PUK + 7.602 PS8VEK + 2.376 PS8FDK + 4.5732 PS8WHE
   + 4.34454 PS8WHL + 3.11809 PS8BAR + 10.3782 PS8HVA + 6.30105 PS8TOR
   + 5.226 PS8NOR + 3.4594 PS8FDR + 22.82 PS8FRU + 4.942 PM7RIB
   + 13.5905 PM7RIO + 1.9 PM7COG + 9.48575 PM7COT + 11.4 PM7SUG
   + 2.05182 PM7TOK + 6.968 PM7NOK + 3.11116 PM7PUK + 10.136 PM7VEK
   + 3.168 PM7FDK + 17.80355 PM7WHE + 16.91337 PM7WHL + 4.15745 PM7BAR
   + 7.57773 PM7PUR + 13.8376 PM7HVA . 8.4014 PM7TOR + 6.968 PM7NOR
   + 4.61253 PM7FDR + 45.65 PM7FRU + 5.6833 PM8RIB + 8.52495 PM8RIO
   + 3.8 PM8COG + 9.48575 PM8COT + 11.4 PM8SUG + 2.05182 PM8TOK
   + 6.968 PM8NOK + 3.11116 PM8PUK + 10.136 PM8VEK + 3.168 PM8FDK
   + 6.0976 PM8WHE + 5.79272 PM8WHL + 4.15745 PM8BAR + 13.8376 PM8HVA
   + 8.4014 PM8TOR + 6.968 PM8NOR + 4.61253 PM8FDR + 45.65 PM8FRU
   + 12.40442 PL7RIB + 12.18203 PL7RIO + 2.375 PL7COG + 12.3205 PL7COT
   + 14.25 PL7SUG + 2.56477 PL7TOK + 8.71 PL7NOK + 3.88895 PL7PUK
   + 12.67 PL7VEK + 3.96 PL7FDK + 24.6894 PL7WHE + 23.45493 PL7WHL
   + 5.19682 PL7BAR + 9.47216 PL7PUR + 17.297 PL7HVA + 10.50175 PL7TOR
   + 8.71 PL7NOR + 5.76566 PL7FDR + 91.29 PL7FRU + 5.21381 PL8RIB
   + 16.63 PL8RIO + 4.75 PL8COG + 12.3205 PL8COT + 14.25 PL8SUG
   + 2.56477 PL8TOK + 8.71 PL8NOK + 3.88895 PL8PUK + 12.67 PL8VEK
   + 3.96 PL8FDK + 7.622 PL8WHE + 7.2409 PL8WHL + 5.19682 PL8BAR
   + 17.297 PL8HVA + 10.50175 PL8TOR + 8.71 PL8NOR + 5.76566 PL8FDR
   + 91.29 PL8FRU - INPTTR <=   0
```

NWFP REGIONAL RESOURCE RESTRICTIONS

```
NPRFENK)   89.30731 PS7RIB + 57.93634 PS7RIO + 42.00096 PS7COG
   + 82.31036 PS7COT + 74.56372 PS7SUG + 7.71779 PS7TOK + 59.99314 PS7NOK
   + 212.5999 PS7VEK + 39.42516 PS7FDK + 128.1174 PS7FRU
   + 46.88345 PS8RIB + 47.14296 PS8RIO + 27.43037 PS8COG
   + 82.28152 PS8COT + 74.56372 PS8SUG + 7.71779 PS8TOK + 29.99657 PS8NOK
   + 212.5999 PS8VEK + 39.42516 PS8FDK + 128.1174 PS8FRU
   + 53.77469 PM7RIB + 27.43037 PM7RIO + 42.00096 PM7COG
   + 82.28152 PM7COT + 74.56372 PM7SUG + 7.71779 PM7TOK + 59.99314 PM7NOK
   + 212.5999 PM7VEK + 39.42516 PM7FDK + 128.1174 PM7FRU + 60.9927 PM8RIB
   + 27.43037 PM8COG + 82.28152 PM8COT + 74.56372 PM8SUG + 7.71779 PM8TOK
   + 29.99657 PM8NOK + 212.5999 PM8VEK + 39.42516 PM8FDK
   + 128.1174 PM8FRU + 79.24438 PL7RIB + 89.15353 PL7RIO
   + 42.00096 PL7COG + 82.28152 PL7COT + 74.56372 PL7SUG + 7.71779 PL7TOK
   + 59.99314 PL7NOK + 212.5999 PL7VEK + 39.42516 PL7FDK
   + 128.1174 PL7FRU + 51.50644 PL8RIB + 47.14296 PL8RIO
   + 27.39193 PL8COG + 82.28152 PL8COT + 74.56372 PL8SUG + 7.71779 PL8TOK
   + 29.99657 PL8NOK + 212.5999 PL8VEK + 39.42516 PL8FDK
   + 128.1174 PL8FRU - A7FENK <=   0
```

```
NPRFEPK)   36.69423 PS7RIB + 21.90807 PS7RIO + 10.31449 PS7COG
    + 27.38253 PS7COT + 17.22152 PS7SUG + 9.12751 PS7TOK + 19.84108 PS7NOK
    + 36.51004 PS7VEK + 7.94052 PS7FDK + 22.81878 PS7FRU + 6.05772 PS8RIB
    + 9.12751 PS8RIO + 9.12751 PS8COG + 27.38253 PS8COT + 17.22152 PS8SUG
    + 9.12751 PS8TOK + 9.92565 PS8NOK + 36.51004 PS8VEK + 7.94052 PS8FDK
    + 22.81878 PS8FRU + 16.97594 PM7RIB + 9.12751 PM7RIO + 10.31449 PM7COG
    + 27.38253 PM7COT + 17.22152 PM7SUG + 9.12751 PM7TOK + 19.84108 PM7NOK
    + 36.51004 PM7VEK + 7.94052 PM7FDK + 22.81878 PM7FRU + 14.26429 PM8RIB
    + 9.12751 PM8COG + 27.38253 PM8COT + 17.22152 PM8SUG + 9.12751 PM8TOK
    + 9.92565 PM8NOK + 36.51004 PM8VEK + 7.94052 PM8FDK + 22.81878 PM8FRU
    + 30.8514 PL7RIB + 27.38253 PL7RIO + 10.31449 PL7COG + 27.38253 PL7COT
    + 17.22152 PL7SUG + 9.12751 PL7TOK + 19.84108 PL7NOK + 36.51004 PL7VEK
    + 7.94052 PL7FDK + 22.81878 PL7FRU + 11.52194 PL8RIB + 9.12751 PL8RIO
    + 9.12751 PL8COG + 27.38253 PL8COT + 17.22152 PL8SUG + 9.12751 PL8TOK
    + 9.92565 PL8NOK + 36.51004 PL8VEK + 7.94052 PL8FDK + 22.81878 PL8FRU
    - A7FEPK <=   0

NPRFEKK)   7.33481 PS7TOK + 7.33481 PS7VEK + 1.1669 PS7FDK
    + 14.66962 PS7FRU + 5.86482 PS8RIB + 4.42513 PS8RIO + 17.60961 PS8SUG
    + 7.33481 PS8TOK + 7.33481 PS8VEK + 1.1669 PS8FDK + 14.66962 PS8FRU
    + 7.33481 PM7TOK + 7.33481 PM7VEK + 1.1669 PM7FDK + 14.66962 PM7FRU
    + 8.8048 PM8RIB + 3.6674 PM8RIO + 7.33481 PM8TOK + 7.33481 PM8VEK
    + 1.1669 PM8FDK + 14.66962 PM8FRU + 19.0796 PL7RIB + 14.68478 PL7RIO
    + 7.33481 PL7TOK + 7.33481 PL7VEK + 1.1669 PL7FDK + 14.66962 PL7FRU
    + 14.68478 PL8RIB + 3.6674 PL8RIO + 17.60961 PL8SUG + 7.33481 PL8TOK
    + 7.33481 PL8VEK + 1.1669 PL8FDK + 14.66962 PL8FRU - A7FEKK <=   0

NPLFENK)   A7FENK <=   41460

NPLFEPK)   A7FEPK <=   10870

NPLFEKK)   A7FEKK <=   1980

NPRBULK)   66.66758 PS7RIB + 51.6439 PS7RIO + 7.097 PS7COG + 27.42 PS7COT
    + 47.524 PS7SUG + 5.35465 PS7TOK + 37.62 PS7NOK + 48.10402 PS7PUK
    + 26.452 PS7VEK + 8.6 PS7FDK + 266.025 PS7FRU + 143.4168 PS8RIB
    + 35.052 PS8RIO + 19.136 PS8COG + 27.42 PS8COT + 47.524 PS8SUG
    + 5.35465 PS8TOK + 37.62 PS8NOK + 48.10402 PS8PUK + 26.452 PS8VEK
    + 8.6 PS8FDK + 266.025 PS8FRU + 49.09877 PM7RIB + 4.942 PM7RIO
    + 4.784 PM7COG + 13.71 PM7COT + 33.646 PM7SUG + 2.67732 PM7TOK
    + 28.694 PM7NOK + 43.82001 PM7PUK + 13.226 PM7VEK + 4.3 PM7FDK
    + 236.465 PM7FRU + 110.5526 PM8RIB + 4.942 PM8RIO + 14.51 PM8COG
    + 13.71 PM8COT + 33.646 PM8SUG + 2.67732 PM8TOK + 28.694 PM8NOK
    + 43.82001 PM8PUK + 13.226 PM8VEK + 4.3 PM8FDK + 236.465 PM8FRU
    + 2.471 PL7COG + 19.768 PL7SUG + 19.768 PL7NOK + 39.536 PL7PUK
    + 177.35 PL7FRU + 46.25712 PL8RIB + 9.884 PL8COG + 19.768 PL8SUG
    + 19.768 PL8NOK + 39.536 PL8PUK + 177.35 PL8FRU <=   586450

NPRFENR)   21.83143 PS7WHE + 24.03774 PS7WHL + 9.97252 PS7BAR
    + 4.48984 PS7PUR + 86.76313 PS7HVA + 31.91427 PS7TOR + 34.90382 PS7NOR
    + 10.86607 PS7FDR + 74.84906 PS7FRU + 22.81023 PS8WHE
    + 25.09126 PS8WHL + 86.76313 PS8HVA + 31.91427 PS8TOR
    + 17.45191 PS8NOR + 10.86607 PS8FDR + 74.84906 PS8FRU
    + 31.40682 PM7WHE + 33.68925 PM7WHL + 12.96207 PM7BAR + 4.48984 PM7PUR
    + 86.76313 PM7HVA + 31.91427 PM7TOR + 34.90382 PM7NOR
    + 10.86607 PM7FDR + 74.84906 PM7FRU + 23.16625 PM8WHE + 24.2694 PM8WHL
    + 86.76313 PM8HVA + 31.91427 PM8TOR + 17.45191 PM8NOR
    + 10.86607 PM8FDR + 74.84906 PM8FRU + 52.95143 PL7WHE + 56.2609 PL7WHL
    + 14.95878 PL7BAR + 4.48984 PL7PUR + 86.76313 PL7HVA + 31.91427 PL7TOR
    + 34.90382 PL7NOR + 10.86607 PL7FDR + 74.84906 PL7FRU
    + 23.16625 PL8WHE + 25.3174 PL8WHL + 86.76313 PL8HVA + 31.91427 PL8TOR
    + 17.45191 PL8NOR + 10.86607 PL8FDR + 74.84906 PL8FRU - A7FENR <=   0
```

```
NPRFEPR)   5.44675 PS7PUR + 21.77581 PS7HVA + 10.89351 PS7TOR
    + 11.83492 PS7NOR + 2.60009 PS7FDR + 13.61688 PS7FRU + 11.431 PS8WHE
    + 12.5741 PS8WHL + 21.77581 PS8HVA + 10.89351 PS8TOR + 5.91746 PS8NOR
    + 2.60009 PS8FDR + 13.61688 PS8FRU + 7.84512 PM7WHE + 8.96585 PM7WHL
    + 5.44675 PM7PUR + 21.77581 PM7HVA + 10.89351 PM7TOR + 11.83492 PM7NOR
    + 2.60009 PM7FDR + 13.61688 PM7FRU + 11.20731 PM8WHE + 12.32804 PM8WHL
    + 21.77581 PM8HVA + 10.89351 PM8TOR + 5.91746 PM8NOR + 2.60009 PM8FDR
    + 13.61688 PM8FRU + 10.08658 PL7WHE + 11.20731 PL7WHL + 5.44675 PL7PUR
    + 21.77581 PL7HVA + 10.89351 PL7TOR + 11.83492 PL7NOR + 2.60009 PL7FDR
    + 13.61688 PL7FRU + 11.20731 PL8WHE + 12.32804 PL8WHL
    + 21.77581 PL8HVA + 10.89351 PL8TOR + 5.91746 PL8NOR + 2.60009 PL8FDR
    + 13.61688 PL8FRU - A7FEPR <=   0

NPRFEKR)   32.46034 PS7HVA + 16.20436 PS7FRU + 32.46034 PS8HVA
    + 16.20436 PS8FRU + 32.46034 PM7HVA + 16.20436 PM7FRU
    + 32.46034 PM8HVA + 16.20436 PM8FRU + 32.46034 PL7HVA
    + 16.20436 PL7FRU + 32.46034 PL8HVA + 16.20436 PL8FRU - A7FEKR
    <=   0

NLPFENR)   A7FENR <=   41720

NLPFEPR)   A7FEPR <=   14900

NPLFEKR)   A7FEKR <=   3300

NPRBULR)   36.96616 PS7WHE + 35.11785 PS7WHL + 149.7558 PS7BAR
    + 58.5627 PS7PUR + 266.868 PS7HVA + 21.2506 PS7TOR + 37.62 PS7NOR
    + 15.8144 PS7FDR + 266.025 PS7FRU + 164.7314 PS8WHE + 156.4948 PS8WHL
    + 149.7558 PS8BAR + 177.912 PS8PUR + 266.868 PS8HVA + 21.2506 PS8TOR
    + 37.62 PS8NOR + 15.8144 PS8FDR + 266.025 PS8FRU + 17.93946 PM7WHE
    + 17.04248 PM7WHL + 149.7558 PM7BAR + 49.6671 PM7PUR + 133.434 PM7HVA
    + 11.8608 PM7TOR + 28.694 PM7NOR + 7.9072 PM7FDR + 236.465 PM7FRU
    + 164.7314 PM8WHE + 156.4948 PM8WHL + 149.7558 PM8BAR + 177.912 PM8PUR
    + 133.434 PM8HVA + 11.8608 PM8TOR + 28.694 PM8NOR + 7.9072 PM8FDR
    + 236.465 PM8FRU + 149.7558 PL7BAR + 40.7715 PL7PUR + 2.471 PL7TOR
    + 19.768 PL7NOR + 177.35 PL7FRU + 164.7314 PL8WHE + 156.4948 PL8WHL
    + 149.7558 PL8BAR + 177.912 PL8PUR + 2.471 PL8TOR + 19.768 PL8NOR
    + 177.35 PL8FRU <=   586450

NPRFYM)   28.4165 PS7RIB + 9.884 PS7COG + 12.355 PS7SUG + 2.471 PS7FDK
    + 6.79525 PS7WHE + 6.45548 PS7WHL + 148.26 PS7HVA + 3.7065 PS7FDR
    + 81.07 PS7FRU + 1.2355 PS8RIO + 9.884 PS8COG + 12.355 PS8SUG
    + 2.471 PS8FDK + 148.26 PS8HVA + 3.7065 PS8FDR + 81.07 PS8FRU
    + 18.23598 PM7RIB + 4.942 PM7RIO + 9.884 PM7COG + 12.355 PM7SUG
    + 2.471 PM7FDK + 5.4362 PM7WHE + 5.16439 PM7WHL + 148.26 PM7HVA
    + 3.7065 PM7FDR + 81.07 PM7FRU + 9.884 PM8COG + 12.355 PM8SUG
    + 2.471 PM8FDK + 148.26 PM8HVA + 3.7065 PM8FDR + 81.07 PM8FRU
    + 22.26371 PL7RIB + 9.884 PL7COG + 12.355 PL7SUG + 2.471 PL7VEK
    + 2.471 PL7FDK + 8.1543 PL7WHE + 7.74658 PL7WHL + 148.26 PL7HVA
    + 3.7065 PL7FDR + 81.07 PL7FRU + 1.2355 PL8RIO + 9.884 PL8COG
    + 12.355 PL8SUG + 2.471 PL8VEK + 2.471 PL8FDK + 148.26 PL8HVA
    + 3.7065 PL8FDR + 81.07 PL8FRU <=   58470

NPRTOWK)   8.74734 PS7RIB + 8.327269 PS7RIO + 3.08875 PS7COG
    + 4.81845 PS7COT + 4.744 PS7SUG + 1.35905 PS7TOK + 3.77445 PS7NOK
    + 1.35905 PS7PUK + 8.85606 PS7VEK + 2.84165 PS7FDK + 5.745 PS7FRU
    + 0.76336 PS8RIB + 0.72464 PS8RIO + 0.86113 PS8COG + 0.86113 PS8COT
    + 0.461 PS8SUG + 1.05409 PS8TOK + 1.05409 PS8NOK + 1.05409 PS8PUK
    + 1.05409 PS8VEK + 1.05409 PS8FDK + 8.74734 PM7RIB + 8.327269 PM7RIO
    + 3.08875 PM7COG + 4.81845 PM7COT + 4.745 PM7SUG + 1.35905 PM7TOK
    + 3.77445 PM7NOK + 1.35905 PM7PUK + 8.85606 PM7VEK + 2.84165 PM7FDK
    + 5.745 PM7FRU + 0.76336 PM8RIB + 0.72464 PM8RIO + 0.86113 PM8COG
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    + 0.86113 PM8COT + 0.461 PM8SUG + 1.05409 PM8TOK + 1.05409 PM8NOK
    + 1.05409 PM8PUK + 1.05409 PM8VEK + 1.05409 PM8FDK + 0.915 PM8FRU
    + 8.74734 PL7RIB + 8.327269 PL7RIO + 3.08875 PL7COG + 4.81845 PL7COT
    + 4.745 PL7SUG + 1.35905 PL7TOK + 3.77445 PL7NOK + 1.35905 PL7PUK
    + 8.85606 PL7VEK + 2.84165 PL7FDK + 5.745 PL7FRU + 0.76336 PL8RIB
    + 0.72464 PL8RIO + 0.86113 PL8COG + 0.86113 PL8COT + 0.461 PL8SUG
    + 1.05409 PL8TOK + 1.05409 PL8NOK + 1.05409 PL8PUK + 1.05409 PL8VEK
    + 1.05409 PL8FDK + 0.915 PL8FRU - IB7CAK - IB7TUK <=   0

NPRTOWR)   4.745 PS7SUG + 3.68179 PS7WHE + 3.65708 PS7WHL + 3.08875 PS7BAR
    + 1.35905 PS7PUR + 3.7065 PS7HVA + 2.84165 PS7TOR + 3.77445 PS7NOR
    + 5.4362 PS7FDR + 5.745 PS7FRU + 0.4611 PS8SUG + 0.77 PS8WHE
    + 0.64 PS8WHL + 0.77 PS8BAR + 0.77 PS8PUR + 0.77 PS8HVA + 0.77 PS8TOR
    + 0.77 PS8NOR + 0.77 PS8FDR + 0.915 PS8FRU + 4.744 PM7SUG
    + 3.68179 PM7WHE + 2.64397 PM7WHL + 3.08875 PM7BAR + 1.35905 PM7PUR
    + 3.7065 PM7HVA + 2.84165 PM7TOR + 3.77445 PM7NOR + 5.4362 PM7FDR
    + 5.745 PM7FRU + 0.4611 PM8SUG + 0.77 PM8WHE + 0.64 PM8WHL
    + 0.77 PM8BAR + 0.77 PM8PUR + 0.77 PM8HVA + 0.77 PM8TOR + 0.77 PM8NOR
    + 0.77 PM8FDR + 0.915 PM8FRU + 4.744 PL7SUG + 3.68179 PL7WHE
    + 2.64397 PL7WHL + 3.08875 PL7BAR + 1.35905 PL7PUR + 3.7065 PL7HVA
    + 2.84165 PL7TOR + 3.77445 PL7NOR + 5.4362 PL7FDR + 5.745 PL7FRU
    + 0.4611 PL8SUG + 0.77 PL8WHE + 0.64 PL8WHL + 0.77 PL8BAR
    + 0.77 PL8PUR + 0.77 PL8HVA + 0.77 PL8TOR + 0.77 PL8NOR + 0.77 PL8FDR
    + 0.915 PL8FRU - IB7CAR - IB7TUR <=   0

NPRCAWK)   0.915 PS8FRU + IB7CAK <=   1311

NPRCAWR)   IB7CAR <=   2093

NPRTUWK)   IB7TUK <=   540

NPRTUWR)   IB7TUR <=   540

 NPRHLK)   6.1775 PS7RIB + 86.9792 PS7RIO + 116.6312 PS7COG
    + 122.5616 PS7COT + 197.68 PS7SUG + 264.1069 PS7TOK + 173.9584 PS7NOK
    + 75.1184 PS7PUK + 193.7264 PS7VEK + 13.8376 PS7FDK + 188.66 PS7FRU
    + 196.1727 PS8RIB + 134.4224 PS8RIO + 15.8144 PS8COG + 122.5616 PS8COT
    + 197.68 PS8SUG + 264.1069 PS8TOK + 130.4688 PS8NOK + 75.1184 PS8PUK
    + 193.7264 PS8VEK + 13.8376 PS8FDK + 188.66 PS8FRU + 88.33825 PM7RIB
    + 158.144 PM7RIO + 179.4934 PM7COG + 184.2378 PM7COT + 316.288 PM7SUG
    + 528.2138 PM7TOK + 267.8564 PM7NOK + 119.6755 PM7PUK + 271.81 PM7VEK
    + 38.0534 PM7FDK + 440.21 PM7FRU + 298.0273 PM8RIB + 197.68 PM8RIO
    + 19.768 PM8COG + 184.2378 PM8COT + 316.288 PM8SUG + 528.2138 PM8TOK
    + 200.8923 PM8NOK + 119.6755 PM8PUK + 271.81 PM8VEK + 38.0534 PM8FDK
    + 440.21 PM8FRU + 109.1194 PL7RIB + 59.304 PL7RIO + 247.4954 PL7COG
    + 216.4596 PL7COT + 438.8496 PL7SUG + 897.9634 PL7TOK + 370.65 PL7NOK
    + 174.1166 PL7PUK + 356.8124 PL7VEK + 67.2112 PL7FDK + 565.985 PL7FRU
    + 298.4474 PL8RIB + 310.3576 PL8RIO + 22.7332 PL8COG + 216.4596 PL8COT
    + 438.8496 PL8SUG + 897.9634 PL8TOK + 277.9875 PL8NOK
    + 174.1166 PL8PUK + 356.8124 PL8VEK + 67.2112 PL8FDK + 565.985 PL8FRU
    - ANPHLK <=   0

NPRHLR)   13.04688 PS7WHE + 12.39453 PS7WHL + 71.19148 PS7BAR
    + 15.8144 PS7PUR + 268.8448 PS7HVA + 27.6752 PS7TOR + 173.9584 PS7NOR
    + 3.9536 PS7FDR + 188.66 PS7FRU + 104.4142 PS8WHE + 99.19347 PS8WHL
    + 71.19148 PS8BAR + 268.8448 PS8HVA + 27.6752 PS8TOR + 130.4688 PS8NOR
    + 3.9536 PS8FDR + 188.66 PS8FRU + 42.2541 PM7WHE + 46.47951 PM7WHL
    + 82.06833 PM7BAR + 35.0882 PM7PUR + 441.8148 PM7HVA + 60.2924 PM7TOR
    + 267.8564 PM7NOR + 18.16679 PM7FDR + 440.21 PM7FRU + 120.3669 PM8WHE
    + 114.3486 PM8WHL + 82.06833 PM8BAR + 441.8148 PM8HVA + 60.2924 PM8TOR
    + 200.8923 PM8NOR + 18.16679 PM8FDR + 440.21 PM8FRU + 91.32816 PL7WHE
    + 86.76175 PL7WHL + 100.8568 PL7BAR + 51.891 PL7PUR + 601.9356 PL7HVA
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     + 87.9676 PL7TOR + 370.65 PL7NOR + 27.74438 PL7FDR + 565.985 PL7FRU
     + 147.9234 PL8WHE + 140.5272 PL8WHL + 100.8568 PL8BAR
     + 601.9356 PL8HVA + 87.9676 PL8TOR + 277.9875 PL8NOR + 27.74438 PL8FDR
     + 565.985 PL8FRU - ANPHLR <=   0

  NLPHLK)   ANPHLK <=   93080

  NLPHLR)   ANPHLR <=   93080
```

NWFP
SMALL FARM RESOURCE RESTRICTIONS

```
NPSRFALK)   609.0274 PS7RIB + 515.8954 PS7RIO + 212.6842 PS7COG
     + 233.0072 PS7COT + 417.1856 PS7SUG + 797.6753 PS7TOK
     + 357.8616 PS7NOK + 205.655 PS7PUK + 257.7376 PS7VEK + 149.9412 PS7FDK
     + 706 PS7FRU + 394.4135 PS8RIB + 295.9896 PS8RIO + 43.846 PS8COG
     + 233.0072 PS8COT + 417.1856 PS8SUG + 797.6753 PS8TOK
     + 277.8012 PS8NOK + 205.655 PS8PUK + 257.7376 PS8VEK + 149.9412 PS8FDK
     + 706 PS8FRU <=   3308587

 NPSRLAK)   PS7RIB + PS7RIO + PS7COG + PS7COT + PS7SUG + PS7TOK + PS7NOK
     + PS7PUK + PS7VEK + PS7FDK + PS7FRU + PS8RIB + PS8RIO + PS8COG
     + PS8COT + PS8SUG + PS8TOK + PS8NOK + PS8PUK + PS8VEK + PS8FDK
     + PS8FRU <=   914

NPSRFALR)   110.7008 PS7WHE + 105.1658 PS7WHL + 187.3328 PS7BAR
     + 121.8203 PS7PUR + 719.5552 PS7HVA + 131.9514 PS7TOR
     + 357.8616 PS7NOR + 72.10378 PS7FDR + 706 PS7FRU + 189.8655 PS8WHE
     + 208.8521 PS8WHL + 187.3328 PS8BAR + 362.3475 PS8PUR
     + 719.5552 PS8HVA + 131.9514 PS8TOR + 277.8012 PS8NOR
     + 72.10378 PS8FDR + 706 PS8FRU <=   3308587

 NPSRLAR)   PS7SUG + PS7WHE + PS7WHL + PS7BAR + PS7PUR + PS7HVA + PS7TOR
     + PS7NOR + PS7FDR + PS7FRU + PS8SUG + PS8WHE + PS8WHL + PS8BAR
     + PS8PUR + PS8HVA + PS8TOR + PS8NOR + PS8FDR + PS8FRU <=   1178

NPSROBCW)   PS7RIB + PS7WHE + PS8RIB + PS8WHE <=   1178

NPSMKTSW)   1868.248 PS7WHE + 1774.836 PS7WHL + 792.2446 PS8WHE
     + 752.6324 PS8WHL + HS7WHE >=   1175061

NPSMKTSR)   2450.105 PS7RIB + 2727.601 PS7RIO + 14.80741 PS8RIB + 15 PS8RIO
     + HS7RIC >=   80028
```

NWFP
MEDIUM FARM RESOURCE RESTRICTIONS

```
NPMRFALK)   581.8217 PM7RIB + 405.244 PM7RIO + 146.5206 PM7COG
     + 152.6791 PM7COT + 282.7228 PM7SUG + 530.8911 PM7TOK
     + 255.0376 PM7NOK + 156.8139 PM7PUK + 166.428 PM7VEK + 115.495 PM7FDK
     + 425.125 PM7FRU + 262.272 PM8RIB + 202.622 PM8RIO + 21.4288 PM8COG
     + 152.6791 PM8COT + 282.7228 PM8SUG + 530.8911 PM8TOK
     + 198.4517 PM8NOK + 156.8139 PM8PUK + 166.428 PM8VEK + 115.495 PM8FDK
     + 425.125 PM8FRU <=   478271

 NPMRLAK)   PM7RIB + PM7RIO + PM7COG + PM7COT + PM7SUG + PM7TOK + PM7NOK
     + PM7PUK + PM7VEK + PM7FDK + PM7FRU + PM8RIB + PM8RIO + PM8COG
     + PM8COT + PM8SUG + PM8TOK + PM8NOK + PM8PUK + PM8VEK + PM8FDK
     + PM8FRU <=   226

NPMRFALR)   68.07605 PM7WHE + 74.88365 PM7WHL + 176.4559 PM7BAR
     + 84.7553 PM7PUR + 413.1512 PM7HVA + 72.1532 PM7TOR + 255.0376 PM7NOR
```

```
     + 41.08778 PM7FDR + 425.125 PM7FRU + 176.0882 PM8WHE + 193.697 PM8WHL
     + 176.4559 PM8BAR + 362.3475 PM8PUR + 413.1512 PM8HVA + 72.1532 PM8TOR
     + 198.4517 PM8NOR + 41.08778 PM8FDR + 425.125 PM8FRU <=   478271

 NPMRLAR)   PM7SUG + PM7WHE + PM7WHL + PM7BAR + PM7PUR + PM7HVA + PM7TOR
     + PM7NOR + PM7FDR + PM7FRU + PM8SUG + PM8WHE + PM8WHL + PM8BAR
     + PM8PUR + PM8HVA + PM8TOR + PM8NOR + PM8FDR + PM8FRU <=   415

NPMROBCW)   PM7RIB + PM7WHE + PM8RIB + PM8WHE <=   415

NPMMKTSW)   1888.869 PM7WHE + 1794.425 PM7WHL + 790.4984 PM8WHE
     + 750.9735 PM8WHL + HM7WHE >=   165536

NPMMKTSR)   2577.715 PM7RIB + 2869.664 PM7RIO + 15.57863 PM8RIB + 16 PM8RIO
     + HM7RIC >=   11274
```

NWFP
LARGE FARM RESOURCE RESTRICTIONS

```
NPLRFALK)   429.4104 PL7RIB + 268.2518 PL7RIO + 75.21724 PL7COG
     + 60.2924 PL7COT + 144.3064 PL7SUG + 158.4641 PL7TOK + 143.318 PL7NOK
     + 98.08881 PL7PUK + 68.1996 PL7VEK + 81.0488 PL7FDK + 240.235 PL7FRU
     + 208.6513 PL8RIB + 85.0024 PL8RIO + 11.8608 PL8COG + 60.2924 PL8COT
     + 144.3064 PL8SUG + 158.4641 PL8TOK + 112.4305 PL8NOK
     + 98.08881 PL8PUK + 68.1996 PL8VEK + 81.0488 PL8FDK + 240.235 PL8FRU
     <=   312697

 NPLRLAK)   PL7RIB + PL7RIO + PL7COG + PL7COT + PL7SUG + PL7TOK + PL7NOK
     + PL7PUK + PL7VEK + PL7FDK + PL7FRU + PL8RIB + PL8RIO + PL8COG
     + PL8COT + PL8SUG + PL8TOK + PL8NOK + PL8PUK + PL8VEK + PL8FDK
     + PL8FRU <=   202

NPLRFALR)   33.80328 PL7WHE + 37.1836 PL7WHL + 157.6674 PL7BAR
     + 58.0685 PL7PUR + 119.5964 PL7HVA + 33.1114 PL7TOR + 143.318 PL7NOR
     + 22.61459 PL7FDR + 240.235 PL7FRU + 152.2894 PL8WHE + 167.5184 PL8WHL
     + 157.6674 PL8BAR + 362.3475 PL8PUR + 119.5964 PL8HVA + 33.1114 PL8TOR
     + 112.4305 PL8NOR + 22.61459 PL8FDR + 240.235 PL8FRU <=   312697

 NPLRLAR)   PL7SUG + PL7WHE + PL7WHL + PL7BAR + PL7PUR + PL7HVA + PL7TOR
     + PL7NOR + PL7FDR + PL7FRU + PL8SUG + PL8WHE + PL8WHL + PL8BAR
     + PL8PUR + PL8HVA + PL8TOR + PL8NOR + PL8FDR + PL8FRU <=   506

NPLROBCW)   PL7RIB + PL7WHE + PL8RIB + PL8WHE <=   506

NPLMKTSW)   1963.104 PL7WHE + 1864.949 PL7WHL + 821.5309 PL8WHE
     + 780.4544 PL8WHL + HL7WHE >=   109268

NPLMKTSR)   2564.954 PL7RIB + 2855.457 PL7RIO + 15.50151 PL8RIB + 17 PL8RIO
     + HL7RIC >=   7442

 NPFFEED) - 266.2905 PS7RIB - 353.6801 PS7RIO - 823.8639 PS7COG
     - 41.22179 PS7COT - 417.63 PS7SUG - 212.2041 PS7PUK - 907.3 PS7VEK
     - 421.2372 PS7WHE - 381.6253 PS7WHL - 306.683 PS7BAR - 225.5849 PS7PUR
     - 119.8 PS7HVA - 31.10074 PS8RIB - 193.3629 PS8RIO - 374.6977 PS8COG
     - 38.35679 PS8COT - 305.13 PS8SUG - 109.9725 PS8PUK - 767.65 PS8VEK
     - 200.0867 PS8WHE - 179.3749 PS8WHL - 174.7831 PS8BAR
     - 131.7629 PS8PUR - 359.95 PS8HVA - 280.1114 PM7RIB - 371.9463 PM7RIO
     - 915.5202 PM7COG - 40.81963 PM7COT - 434.34 PM7SUG - 163.3108 PM7PUK
     - 698.6 PM7VEK - 425.9303 PM7WHE - 385.8638 PM7WHL - 310.0926 PM7BAR
     - 228.0336 PM7PUR - 110.2 PM7HVA - 32.71786 PM8RIB - 203.3494 PM8RIO
     - 408.6306 PM8COG - 12.73041 PM8COT - 317.34 PM8SUG - 83.2803 PM8PUK
     - 591.1 PM8VEK - 200.6648 PM8WHE - 179.816 PM8WHL - 176.7277 PM8BAR
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```
     - 141.804 PM8PUR - 331.15 PM8HVA - 278.8353 PL7RIB - 370.5257 PL7RIO
     - 907.1216 PL7COG - 44.03694 PL7COT - 421.81 PL7SUG - 259.0939 PL7PUK
     - 834.7 PL7VEK - 442.6656 PL7WHE - 401.0423 PL7WHL - 322.1961 PL7BAR
     - 236.9786 PL7PUR - 88.65 PL7HVA - 32.55015 PL8RIB - 202.5727 PL8RIO
     - 407.208 PL8COG - 14.96345 PL8COT - 308.19 PL8SUG - 130.9939 PL8PUK
     - 706.2 PL8VEK - 208.5896 PL8WHE - 186.9082 PL8WHL - 183.6785 PL8BAR
     - 150.1554 PL8PUR - 266.35 PL8HVA + 40.91688 L7MCA1 + 45.01 L7MCA2
     + 40.92 L7MCA3 + 1.84338 L7NMC1 + 2.028 L7NMC2 + 1.843 L7NMC3
     + 0.8753 L7GOS1 + 0.9628 L7GOS2 + 0.9191 L7GOS3 + 13.54497 L7BRO1
     + 16.93121 L7BRO2 + 16.25396 L7BRO3 + 5.08839 L7BRO4 + 4.87637 L7LAY1
     + 6.09546 L7LAY2 + 5.85164 L7LAY3 + 4.24032 L7LAY4 + 4.87637 L7DESI
     + 225.7 L8MCA1 + 248.3 L8MCA2 + 225.7 L8MCA3 + 10.81 L8NMC1
     + 11.89 L8NMC2 + 10.81 L8NMC3 + 4.131 L8GOS1 + 4.544 L8GOS2
     + 4.337 L8GOS3 + 13.09 L8BRO1 + 16.37 L8BRO2 + 15.71 L8BRO3
     + 2.603 L8BRO4 + 8.788 L8LAY1 + 10.99 L8LAY2 + 10.55 L8LAY3
     + 7.642 L8LAY4 + 4.94 L8DESI <=   0

 NPFCAKE)   136.8 L7MCA1 + 136.8 L7MCA2 + 150.56 L7MCA3 + 4.8784 L7NMC1
     + 4.8784 L7NMC2 + 5.3664 L7NMC3 + 0.43072 L7BRO1 + 0.5384 L7BRO2
     + 0.5168799 L7BRO3 + 136.8 L8MCA1 + 136.8 L8MCA2 + 150.56 L8MCA3
     + 4.8784 L8NMC1 + 4.8784 L8NMC2 + 5.3664 L8NMC3 + 0.43072 L8BRO4
     + 0.5384 L8LAY1 + 0.5168799 L8LAY2 + 0.21536 L8LAY4 - DF7CAK <=   0

NPFSTRAW) - 3675.157 PS7RIB - 2727.601 PS7RIO - 2489.614 PS7COG
     - 3990.186 PS7SUG - 1467.374 PS7TOK - 853.75 PS7NOK - 557.7705 PS7PUK
     - 137.4573 PS7VEK - 2335.31 PS7WHE - 2218.545 PS7WHL - 1509.692 PS7BAR
     - 965.3054 PS7PUR - 600.7504 PS7TOR - 891.25 PS7NOR - 22.21112 PS8RIB
     - 1357.883 PS8COG - 3184.337 PS8SUG - 871.1181 PS8TOK
     - 1354.114 PS8NOK - 459.0623 PS8PUK - 1249.128 PS8VEK
     - 990.3057 PS8WHE - 940.7905 PS8WHL - 617.7761 PS8BAR - 580.518 PS8PUR
     - 561.0048 PS8TOR - 1342.316 PS8NOR - 3866.571 PM7RIB
     - 2869.664 PM7RIO - 3156.859 PM7COG - 4135.787 PM7SUG
     - 1128.749 PM7TOK - 811.25 PM7NOK - 429.0542 PM7PUK - 126.7571 PM7VEK
     - 2361.086 PM7WHE - 2243.032 PM7WHL - 1526.355 PM7BAR - 975.96 PM7PUR
     - 462.1157 PM7TOR - 846.25 PM7NOR - 23.36795 PM8RIB - 1589.686 PM8COG
     - 3315.03 PM8SUG - 549.0179 PM8TOK - 1041.763 PM8NOK - 346.4015 PM8PUK
     - 1151.885 PM8VEK - 988.123 PM8WHE - 938.7168 PM8WHL - 624.6062 PM8BAR
     - 640.275 PM8PUR - 251.1996 PM8TOR - 1032.619 PM8NOR - 3847.43 PL7RIB
     - 2855.457 PL7RIO - 3128.16 PL7COG - 4019.663 PL7SUG - 1793.457 PL7TOK
     - 767.5 PL7NOK - 681.7195 PL7PUK - 102.0641 PL7VEK - 2453.88 PL7WHE
     - 2331.186 PL7WHL - 1586.343 PL7BAR - 1014.317 PL7PUR
     - 734.2505 PL7TOR - 801.25 PL7NOR - 23.25227 PL8RIB - 1600.628 PL8COG
     - 2929.392 PL8SUG - 671.2853 PL8TOK - 1655.433 PL8NOK
     - 544.1694 PL8PUK - 927.4755 PL8VEK - 1026.914 PL8WHE
     - 975.5679 PL8WHL - 649.1544 PL8BAR - 682.8713 PL8PUR
     - 448.9013 PL8TOR - 1640.614 PL8NOR + 491.186 L7MCA1 + 540.32 L7MCA2
     + 491.2 L7MCA3 + 491.186 L7NMC1 + 540.32 L7NMC2 + 491.2 L7NMC3
     + 94.16828 L7GOS1 + 103.6 L7GOS2 + 98.88 L7GOS3 + 425.04 L8MCA1
     + 467.6 L8MCA2 + 425.04 L8MCA3 + 425.04 L8NMC1 + 467.6 L8NMC2
     + 425.04 L8NMC3 + 66.88 L8GOS1 + 73.568 L8GOS2 + 70.224 L8GOS3
     <=   0

NPFGREK) - 49.00209 PS7RIB - 54.55201 PS7RIO - 33.19484 PS7COG
     - 12.68362 PS7COT - 13167.61 PS7SUG - 146.7374 PS7TOK - 170.75 PS7NOK
     - 55.77704 PS7PUK - 137.4573 PS7VEK - 60934.78 PS7FDK
     - 740.5777 PS7FRU - 0.29614 PS8RIB - 18.1051 PS8COG - 11.80208 PS8COT
     - 10508.32 PS8SUG - 87.1118 PS8TOK - 270.8228 PS8NOK - 45.90622 PS8PUK
     - 1249.128 PS8VEK - 28510.08 PS8FDK - 717.2054 PS8FRU
     - 51.55428 PM7RIB - 57.39326 PM7RIO - 42.09144 PM7COG
     - 12.55988 PM7COT - 13648.1 PM7SUG - 112.8749 PM7TOK - 162.25 PM7NOK
     - 42.90542 PM7PUK - 126.7571 PM7VEK - 57888.04 PM7FDK
     - 733.3525 PM7FRU - 0.31157 PM8RIB - 21.1958 PM8COG - 3.91705 PM8COT
```


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```
- 10939.6 PM8SUG - 54.90179 PM8TOK - 208.3525 PM8NOK - 34.64015 PM8PUK
- 1151.885 PM8VEK - 25665.64 PM8FDK - 703.3815 PM8FRU
- 51.29906 PL7RIB - 57.10914 PL7RIO - 41.70879 PL7COG
- 13.54982 PL7COT - 13264.89 PL7SUG - 179.3457 PL7TOK - 153.5 PL7NOK
- 68.17194 PL7PUK - 102.0641 PL7VEK - 54841.3 PL7FDK - 791.1538 PL7FRU
- 0.31003 PL8RIB - 21.3417 PL8COG - 4.60414 PL8COT - 9666.991 PL8SUG
- 67.12852 PL8TOK - 331.0866 PL8NOK - 54.41694 PL8PUK
- 927.4755 PL8VEK - 23628.77 PL8FDK - 748.7913 PL8FRU
+ 503.0856 L7MCA1 + 503.12 L7MCA2 + 503.0856 L7MCA3 + 503.0856 L7NMC1
+ 503.12 L7NMC2 + 503.0856 L7NMC3 + 96.44961 L7GOS1 + 96.48 L7GOS2
+ 96.44961 L7GOS3 + 235.6 L8MCA1 + 235.6 L8MCA2 + 235.6 L8MCA3
+ 235.6 L8NMC1 + 235.6 L8NMC2 + 235.6 L8NMC3 + 37.08 L8GOS1
+ 37.08 L8GOS2 + 37.08 L8GOS3 <=   0

NPFGRER) - 93.41239 PS7WHE - 88.74177 PS7WHL - 60.38765 PS7BAR
- 38.61221 PS7PUR - 1363.447 PS7HVA - 120.1501 PS7TOR - 178.25 PS7NOR
- 29042.29 PS7FDR - 740.5777 PS7FRU - 39.61222 PS8WHE
- 37.63161 PS8WHL - 24.71104 PS8BAR - 23.22072 PS8PUR
- 457.9406 PS8HVA - 112.201 PS8TOR - 268.4631 PS8NOR - 23296.28 PS8FDR
- 717.2054 PS8FRU - 94.44343 PM7WHE - 89.72126 PM7WHL
- 61.05418 PM7BAR - 39.0384 PM7PUR - 1048.805 PM7HVA - 92.42313 PM7TOR
- 169.25 PM7NOR - 27590.17 PM7FDR - 733.3525 PM7FRU - 39.52491 PM8WHE
- 37.54867 PM8WHL - 24.98424 PM8BAR - 25.611 PM8PUR - 430.2325 PM8HVA
- 50.23992 PM8TOR - 206.5238 PM8NOR - 22260.83 PM8FDR
- 703.3815 PM8FRU - 98.15519 PL7WHE - 93.24743 PL7WHL
- 63.45369 PL7BAR - 40.57266 PL7PUR - 1666.435 PL7HVA
- 146.8501 PL7TOR - 160.25 PL7NOR - 26138.06 PL7FDR - 791.1538 PL7FRU
- 41.07654 PL8WHE - 39.02271 PL8WHL - 25.96617 PL8BAR
- 27.31485 PL8PUR - 438.2147 PL8HVA - 89.78026 PL8TOR
- 328.1228 PL8NOR - 21196.16 PL8FDR - 748.7913 PL8FRU
+ 327.2857 L7MCA1 + 327.3 L7MCA2 + 327.2857 L7MCA3 + 327.2857 L7NMC1
+ 327.3 L7NMC2 + 327.2857 L7NMC3 + 62.74595 L7GOS1 + 62.75 L7GOS2
+ 62.74595 L7GOS3 + 444.3 L8MCA1 + 444.3 L8MCA2 + 444.3 L8MCA3
+ 444.3 L8NMC1 + 444.3 L8NMC2 + 444.3 L8NMC3 + 69.91 L8GOS1
+ 69.91 L8GOS2 + 69.91 L8GOS3 <=   0

NPFPAST)   2.08 L7MCA1 + 2.08 L7MCA2 + 2.08 L7MCA3 + 2.08 L7NMC1
+ 2.08 L7NMC2 + 2.08 L7NMC3 + 1.432 L7GOS1 + 1.432 L7GOS2
+ 1.432 L7GOS3 + 3.278 L8MCA1 + 3.278 L8MCA2 + 3.278 L8MCA3
+ 3.278 L8NMC1 + 3.278 L8NMC2 + 3.278 L8NMC3 + 1.853 L8GOS1
+ 1.853 L8GOS2 + 1.853 L8GOS3 <=   15100

NPFFISHM)   2.032 L7BRO1 + 2.54 L7BRO2 + 2.032 L7BRO3 + 2.12 L7BRO4
+ 2.032 L7LAY1 + 2.54 L7LAY2 + 2.032 L7LAY3 + 1.767 L7LAY4
+ 1.963 L8BRO1 + 2.454 L8BRO2 + 1.963 L8BRO3 + 2.048 L8BRO4
+ 1.963 L8LAY1 + 2.454 L8LAY2 + 1.963 L8LAY3 + 1.707 L8LAY4
<=   61600
```

NWFP HERD LEVELS

```
NPHLMCA)   L7MCA1 + L7MCA2 + L7MCA3 + L8MCA1 + L8MCA2 + L8MCA3
=    1890.005

NPHLNMCA)   L7NMC1 + L7NMC2 + L7NMC3 + L8NMC1 + L8NMC2 + L8NMC3
=    4126.005

NPHLGOSH)   L7GOS1 + L7GOS2 + L7GOS3 + L8GOS1 + L8GOS2 + L8GOS3
=    1166.999

NPHLBRO)   L7BRO1 + L7BRO2 + L7BRO3 + L7BRO4 + L8BRO1 + L8BRO2 + L8BRO3
+ L8BRO4 =    23040.03
```


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```
NPHLLAY)   L7LAY1 + L7LAY2 + L7LAY3 + L7LAY4 + L8LAY1 + L8LAY2 + L8LAY3
    + L8LAY4 =    7679.997

NPHLDESI)   L7DESI + L8DESI =    22969.96
```

NATIONAL OILSEED PROCESSING

```
NAPCTS) - 341.5 PS1CO3 - 375.7 PS1CO4 - 338.2 PM1CO3 - 372 PM1CO4
    - 364.9 PL1CO3 - 401.4 PL1CO4 - 592.3 PS2CO3 - 651.5 PS2CO4
    - 586.5 PM2CO3 - 642.2 PM2CO4 - 632.8 PL2CO3 - 696 PL2CO4
    - 425.3 PS3CO3 - 467.8 PS3CO4 - 421.1 PM3CO3 - 463.2 PM3CO4
    - 454.3 PL3CO3 - 499.8 PL3CO4 - 415.3 PS4CO3 - 456.8 PS4CO4
    - 402.9 PM4CO3 - 443.1 PM4CO4 - 394.5 PL4CO3 - 434 PL4CO4
    - 747.8 PS5CO3 - 822.5 PS5CO4 - 725.3 PM5CO3 - 797.9 PM5CO4
    - 710.4 PL5CO3 - 781.4 PL5CO4 - 440.6 PS7COT - 69.89 PS8COT
    - 436.3 PM7COT - 136.1 PM8COT - 470.7 PL7COT - 159.9 PL8COT + MNACTS
    <=   0

NIOTOL) - MPUTOL - MSITOL - MBATOL - MNPTOL + VGDTOL + LOITOL <=   0

NIONOL) - MPUNOK - MPUNOR - MSINOK - MSINOR - MNPNOK - MNPNOR + VGDNOL
    + LOINOL <=   0

NIOCTS) - MNACTS + VGDCTS + LOICTS <=   0

NSELCAK)   DF1CAK + DF2CAK + DF3CAK + DF4CAK + DF5CAK + DF6CAK + DF7CAK
    - 0.67 VGDTOL - 0.6499999 VGDNOL - 0.88 VGDCTS - 0.67 LOITOL
    - 0.6499999 LOINOL - 0.88 LOICTS <=   0
```

LIMITS ON IMPORTS AND EXPORTS

```
EXLRIB)   DRIE1 + DRIE2 + DRIE3 + DRIE4 + DRIE5 + DRIE6 + DRIE7 + DRIE8
    + DRIE9 + DRIE10 + DRIE11 <=   220000

EXLRIO)   EXRIO <=   1000000

EXLCTF)   EXCTF <=   1200000

EXLVEG)   EXVEG <=    100000

EXLFRU)   EXFRU <=     80000

IMLSUG)   IMSUG =     251000

IMLPUL)   IMPUL <=     90000

IMLWHE)   IMWHE <=    100000

IMLSOYO)  IMSOYO <=   500000

IMLPALO)  IMPALO <=   400000

IMLMIL)   IMMIL =     400000
```

SELECTED LIMITS ON ACREAGES IN PRODUCTION

```
LIMTOK)   PS1TOK + PM1TOK + PL1TOK + PS2TOK + PM2TOK + PL2TOK + PS3TOK
    + PM3TOK + PL3TOK + PS4TOK + PM4TOK + PL4TOK + PS5TOK + PM5TOK
    + PL5TOK + PS6TOK + PM6TOK + PL6TOK + PS7TOK + PS8TOK + PM7TOK
    + PM8TOK + PL7TOK + PL8TOK <=   160
```


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```
LIMNOK)   PS1NOK + PM1NOK + PL1NOK + PS2NOK + PM2NOK + PL2NOK + PS3NOK
   + PM3NOK + PL3NOK + PS4NOK + PM4NOK + PL4NOK + PS5NOK + PM5NOK
   + PL5NOK + PS7NOK + PS8NOK + PM7NOK + PM8NOK + PL7NOK + PL8NOK
   <=   6.6

LIMTOR)   PS1TOR + PM1TOR + PL1TOR + PS2TOR + PM2TOR + PL2TOR + PS3TOR
   + PM3TOR + PL3TOR + PS4TOR + PM4TOR + PL4TOR + PS5TOR + PM5TOR
   + PL5TOR + PS6TOR + PM6TOR + PL6TOR + PS7TOR + PS8TOR + PM7TOR
   + PM8TOR + PL7TOR + PL8TOR <=   280

LIMNOR)   PS1NOR + PM1NOR + PL1NOR + PS2NOR + PM2NOR + PL2NOR + PS3NOR
   + PM3NOR + PL3NOR + PS4NOR + PM4NOR + PL4NOR + PS5NOR + PM5NOR
   + PL5NOR + PS7NOR + PS8NOR + PM7NOR + PM8NOR + PL7NOR + PL8NOR
   <=   21.7

LIMPUL)   PS1PUK + PM1PUK + PL1PUK + PS2PUK + PM2PUK + PL2PUK + PS3PUK
   + PM3PUK + PL3PUK + PS4PUK + PM4PUK + PL4PUK + PS5PUK + PM5PUK
   + PL5PUK + PS6PUK + PM6PUK + PL6PUK + PS7PUK + PS8PUK + PM7PUK
   + PM8PUK + PL7PUK + PL8PUK <=   215

LIMFOK)   PS1FDK + PM1FDK + PL1FDK + PS2FDK + PM2FDK + PL2FDK + PS3FDK
   + PM3FDK + PL3FDK + PS4FDK + PM4FDK + PL4FDK + PS5FDK + PM5FDK
   + PL5FDK + PS6FDK + PM6FDK + PL6FDK + PS7FDK + PS8FDK + PM7FDK
   + PM8FDK + PL7FDK + PL8FDK =    1089
```

PN-ABW-324

AGRIBUSINESS CELL

Federal Ministry of Food, Agriculture & Cooperatives, Government of Pakistan

A SIMULATION STUDY OF THE FERTILIZER INDUSTRY IN PAKISTAN

Applying Linear Programming Techniques to Optimize Resource Allocations Utilizing

THE PAKISTAN AGRICULTURAL SECTOR MODEL (PASM)

Prepared by

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in collaboration with
Colorado State University
and
AGRI-BI-CON International (Pvt.) Ltd.
Analysis of Corporate Sector Constraints in Agriculture (ACSCA) Project

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I. EXECUTIVE SUMMARY

Analyzing the impact of changes in policies related to agribusiness activities was one of major objectives of the Pakistan Agricultural Sector Model (PASM), a Linear Programming framework designed to arrive at the optimal allocation of resources among different agricultural activities in Pakistan. Fertilizer, being a crucial agricultural input, involving a number of policy issues, was one of the items which was selected to be studied in detail using PASM. An added incentive to undertake this exercise was the availability of highly useful data generated by the Analysis of Corporate Sector Constraints in Agriculture (ACSCA) project study of individual fertilizer companies in Pakistan in 1990. As a result, besides presenting overall data relating to the industry, the present report has achieved the following tasks:

1. It identifies four set of issues confronting the fertilizer industry which could be analyzed using the PASM. They are: a) Issues relating to investment policy in the fertilizer industry in Pakistan ; b) pricing and availability of natural gas to the industry; c) Fertilizer pricing policy ; and d) the role of public sector in the industry.

   Since these issues have direct or indirect bearing on prices and availability of fertilizers, as well as on the nature of marketing for fertilizers, the model was used to simulate the effect of changes in them on the optimal allocation of cropped area and related agribusiness activities.

2. Simulations were done for the following scenarios.

   a) Raising and lowering of prices by 25 percent for all types of fertilizers: Increases in prices did not change the base solution significantly however they were expected to transfer resources out of agriculture with possible dynamic consequences. As regards decreases in prices by 25 percent, they led to a small increase in cotton, sugarcane and other rice and a decrease of about half percent in wheat area. In the case of basmati rice however the change was quite significant which probably come at the cost of wheat.

   b) Increasing availability of fertilizer by 20 percent leads to significant changes in the base solution of the model. Basmati rice increased by about six percent and similarly cropped area under all other major crops went up. Overall, more acreage is brought into production indicating that at least in some areas the lack of fertilizer limits agricultural production.

3. The model was also used to determine the fertilizer capacity required in the next ten years, i.e. in 1997-98, based on various assumptions about growth trends in resource availability and input use. It was observed that real prices of 1987-88 at doubling the availability would be adequate in ten years. Given that, urea should increase by 50 percent by 1993 and phosphate by 60 percent. This capacity should be close enough to meet the needs. Some additional capacity however would be needed to reduce the dependence on imports.

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4. The report also explains the methodology of using PASM for determining optimal sales prices and production for individual firms in various regions. Policy issues and changes in fertilizer market conditions which can be analyzed using this framework are also identified.

5. One of the major implications of the study is that fertilizer price changes do not seem to change the agricultural output in Pakistan significantly. These changes however do affect profits. On the other hand availability of fertilizers matters a lot. This calls for increase in fertilizer production capacity which, due to the expense involved, can most viably be achieved if there is a good investment climate for the private sector in the country.

6. It is to be noted, however, that this report has not exhausted the potential of using PASM for analyzing the issues related to the fertilizer industry. Only some initial simulations have been done to help show what can be done further on the basis of the data available in the report. An attempt for further work is already underway at Economic Policy Analysis (EPA) project of the Economic wing. In particular the farm level fertilizer coefficients which became the base of our simulations are going to be carefully reviewed by EPA. Similarly an attempt is being made to involve other research institutions and universities in Pakistan to make use of PASM for analyzing the issues related to individual firms identified in the ACSCA fertilizer study.

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II. INTRODUCTION

With the continuous increase in this fertilizer use by farmers in Pakistan, production, imports and marketing of the commodity have become some of the major agribusiness activities in the country. Fertilizer production is a very capital intensive industry; a plant of about 570 thousand metric tons of urea was estimated to cost about $300 million, with a capital: labor ratio of $429,000[4]. Any decision to enhance its domestic production is therefore, likely to have major implications for resource allocation in a capital-scarce country like Pakistan. But increase in its domestic production is necessary to decrease dependence on imports costing about Rs. 4.0 billion in 1987-88. Marketing of fertilizers on the other hand has a lot of bearings on the state of employment in this country as it is a very labor extensive activity. The direct employment effect are also quite significant for the skilled manpower.

In view of these far-reaching implications of the fertilizer industry for Pakistan economy, ACSCA (Analysis of Corporate Sector Constraints in Agriculture) project undertaken by RONCO/Agri-Bi-Con, conducted an in depth study of this activity in 1990. The study covered all the existing fertilizer units in the country and generated a lot of data on production, prices, employment and profitability of those firms. It also identified the major policy issues confronting the industry as an agro business activity.

The idea of PASM (Pakistan Agricultural Sector Model) fertilizer simulations is to analyze some of those policy issues using the structure of the model which could work out the effect of changes in any policy on different aspects of the agricultural sector. The present report is an attempt to explain briefly the nature of the issues which have been (or could be in the future) addressed to the model and the implications for agribusiness activities of alternative policy scenarios.

The report is organized as follows. Part III briefly describes the major policy issues identified by ACSCA and other studies. Part IV discusses the data used in our simulations. In Part V we pick some of the important issues to create different policy scenarios for doing simulations at the aggregate level. And finally, Part VI explains the nature of simulations which could be done for the firm level behaviour in the fertilizer industry.

III. MAJOR POLICY ISSUES RELATING TO FERTILIZER INDUSTRY IN PAKISTAN

The ACSCA Fertilizer and Pesticides Agro-Industry Research Report, Volume I: The Fertilizer Sub-Sector identifies four major area policy issues relating to the fertilizer industry in Pakistan. They are:

1. New investment policy
2. Issues relating to the use and pricing of natural gas in the fertilizer industry
3. Fertilizer pricing policies
4. The role of public sector in fertilizer production and marketing

A brief description of these issues is as follows.

1. Investment Potential: Rising domestic demand has created opportunities for new production facilities in both nitrogenous and phosphatic fertilizers. The alternative scenario envisages rising imports financed by bilateral/multilateral aid, credit, loans, barter trade - thus crowding out other useful economic development activities;

2. Natural Gas is the most important issue affecting private sector investment in new fertilizer production facilities, i.e., the assurance of sufficient gas for ammonia-urea production at "affordable" price levels. Producers are presently the beneficiaries of an indirect subsidy in that the prices of gas to the fertilizer industry are substantially lower than substitute fuels consumed by other industrial sectors and gas consumed by other users. The paradox is this: private business requires assurances of gas supplies at pre-determined and fixed prices as a condition for investment, and yet, such assurances simply continue the heavy subsidies presently accorded to the fertilizer industry.

3. Fertilizer Pricing issues today are related to Government of Pakistan (GOP) retail price control of phosphatic and potassic fertilizers. In May 1986, the government had removed all price controls on nitrogenous fertilizers, but the subsidies for phosphatic and potassic fertilizers stayed in place. In FY 1988, these subsidies were estimated to have cost the government about US$ 80 million.

4. Public Sector Intervention: The GOP through the National Fertilizer Company (NFC) controls about 50 percent of local production and imported fertilizer, and thus has had a moderating influence on pricing actions of the private sector companies. However, non-market price constraints on finished products create pressures for the GOP to subsidize raw material inputs and fertilizer imports. The GOP has also arbitrarily established quotas by province to the private sector for imported fertilizer, probably creating inefficiencies in the marketing system.[4]

Literature on fertilizer, also identifies a number of other issues to highlight the role of this activity into agricultural development of Pakistan. Those issues relate to optimum mix of different types of fertilizers, use of nonchemical fertilizes and the proper water-fertilizer mixing[3].

In our view, all these issues, one way or the other, affects the following aspects of the fertilizer industry.

1. Domestic production of fertilizer
2. Imports of fertilizers
3. Availability of fertilizer at the aggregate and disaggregate levels
4. Cost of production and prices of fertilizers
5. Subsides on fertilizers
6. The nature of the market, both at the production and distribution levels

Our simulations in this report have been based on policy scenarios related to some of these aspects of the industry.

IV. DATA USED

1. Since fertilizer simulations are extensions of the main model it is important to briefly mention the sources of PASM data.

   a) The PASM based most of its technical coefficients on the farm budgets developed by a research team of the Economic Analysis Network (EAN) project for the year 1987-88. This team synthesized different surveys, based on farm budgets, to reach at the most consistent set of estimates. In some cases primary sources were also used to remove the conflicts in different sources of data.

   b) The PASM coefficients relating to livestock were developed by Agri-Bi-Con/RONCO research team on the basis of primary and secondary sources. Details of the methodology used in developing those coefficients are available in the sub-reports prepared for and annexed to the PASM base model report.

   c) For data needed on the right hand side of the model, standard sources like Economic Surveys, Agricultural Statistics of Pakistan, Labour Surveys and Agricultural Censuses were relied upon.

2. As regards the fertilizer coefficients used in the model to get the base run, they were once again derived from the synthesized farm budgets of EAN. However, an important feature of these coefficients is that unlike partial analyses they allowed us to check the use of fertilizer reported in various surveys with the actual availability of the same in different regions of the country. It is an outstanding feature of our model that it allowed us to detect a serious drawback in the estimates of farm level fertilizer-use shown in various farm budgets. Since most of those budgets were used only in partial analyses they could not recognize the fact that total use of chemical fertilizer in the country at any time cannot exceed their availability. Hence in most case they show very high coefficients of fertilizer use at the farm level. This aspect was taken care of by our model where we adjusted the farm-level fertilizer coefficients according to total the availability of fertilizers in a given region. The estimates of these coefficients along with the yields for different crops by size category are presented in the Appendix of this report.

3. Our next set of data were needed for the firm level simulations. Those data related to the following items.

   a. present level of fertilizer production by firm in different zones;
   b. planned capacity expansion by firm in different zones;
   c. average total costs by firm in different zones;
   d. import prices of different types of fertilizers;
   e. total imports of fertilizers by types of fertilizers;
   f. subsidies on imported fertilizers by nutrient varieties; and
   g. transport and handling charges on inter-zone and intra-zone mobility of fertilizer in Pakistan.

A brief description of the sources and methodology of these estimates is presented below.

i) As regards the present level of fertilizer production it was basically the ACSCA Fertilizer Agro-Industry Reserach Report [4] and Agricultural Statistics of Pakistan 1988-89 [2] which enabled us to convert the firm level estimates into zonal ones.

ii) Data on planned capacity was taken from ACSCA [4]

iii) Average total cost of fertilizer production was the hardest part of the estimates. They were basically derived from the ACSCA report, but had to be adjusted under different assumptions to get to the 1987-88 estimates. In most cases, they are averages of 1987-88 estimates. In a few cases we had to inflate 1986-87 figures by 10% to get the 1987-88 level. This was somewhat arbitrary method but not too off the mark when compared with the price of major inputs in fertilizer production, namely natural gas, in the corresponding period.

iv) For required data on import prices are not directly available from any one source, a first approximation information on retail prices and subsidies for individual fertilizers was used to calculate the import prices as follows:

$$IPi = RPi - NSi \quad \text{----------} \quad (1)$$

Where IPi = Import price of ith fertilizer

RPi = Retail price, and

NSi = Net subsidy on Imports of ith fertilizer.

Where NS = 87.5% of the gross subsidy on imported fertilizers; the remaining 12.5% of the total subsidy on imported fertilizers is assumed to go to transport and handling of fertilizers.

v) Data on imports of fertilizers were drawn from Agricultural Statistics of Pakistan 1988-89 [2].

vi) The estimates of transport and handling charges were based on data taken from different market studies. The major items included in our estimates are shown in footnotes to those estimates.

All the data estimates used are presented in Tables 1 to 6.

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Table 1 - Estimates of Average Total Costs, Sales Price and Actual Production of Fertilizers by Firm and Zone in Pakistan 1987-1988

Sl. No.	Zone/Firm (Product)	Actual Production 000' Nutrient Tonnes	Average Total Cost (Rs./Nutrient tonnes)	Sales Price
	(1)	(2)	(3)	(4)
	(a) Nitrogenous Fertilizer			
1	Rice Zone Punjab			
1.1	Dawood Hercules (Urea)	160 (349)	4224 (1943)	5204 (2394)
2.	Punjab Cotton			
2.1	NFC: Pak Arab (Urea)	43 (93)	4443 (2044)	
2.2	Fauji: FFC (Urea)	291 (632)	4529 (2083)	5393 (2481)
2.3	NFC; Pak Arab (NP)	77 (334)	4983 (2292)	4838 (2225)
2.4	NFC: Pak Arab (CAN)	87 (333)	5641 (1474)	NA
2.5	NFC:PAK American (AS/Urea)	20 (98)	6853 (1398)	4603 (939)
3.	Sind Cotton			
3.1	Exxon (Urea)	107 (233)	4198 (1931)	5491 (2526)
3.2	NFC: Pak Saudi (Urea)	267 (580)	4720 (2171)	4659 (2143)
4.	Sind Rice			
4.1	Pak-Steel Mills	2 (9)	6853 (13983)[3]+[3]	NA
5.	NWFP			
5.1	Pak China (Urea)	43 (94)	5867 (2607)	4800 (2208)
	(b) Phosphatic Fertilizers			

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Table 1 - Estimates of Average Total Costs, Sales Price and Actual Production of Fertilizers by Firm and Zone in Pakistan 1987-1988

Sl. No.	Zone/Firm (Product)	Actual Production 000' Nutrient Tonnes	Average Total Cost (Rs./Nutrient tonnes)	Sales Price
	(1)	(2)	(3)	(4)
1.	Punjab Cotton			[4]
1.1	NFC: Pak Arab (NP)	77 (334)	4983 (2292)	4838 (2225)
2.	Punjab Sugarcane			
2.1	NFC: LCQL (SSP 18%)	4 (24)	6872 (1237)	8711 (1568)
2.2	NFC: ;LC2L (SSP 16%)	15 (84)	7731 (1237)	9800 (1568)
3.	NWFP			
3.1	NFC: (SSP 16%)	5 (34)	N.A.	

Source: RONCO Fertilizer Agro-Industry Research Report (Text and Appendix)
NA: Data not available
*: Figures in brackets relate to actual weight in metric tons.

(1) In most cases 'average total cost' is the average of the data for 1987 and 1988. In a few cases the figures for 1986-87 were inflated by 10% to get 1987-88 estimates

(2) Unit sales prices for urea produced by Pak-Saudi, Pak China, and Exxon, Dawood, Fauji were available for 1988. These were discounted by 5% to get 1987-88 data.

(3) Average total cost for this firm was assumed to be equal to the one for NFC Pák American producing AS/Urea, the product closest to the item produced by Pak Steel Mills Plant.

(4) This includes sales price of National Fertilizer Marketing Ltd.(NFML) and price differential paid to this firm.

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Table 2 - Proposed Capacity of Fertilizer Production in Pakistan By Firm, 1990 to 1997

Sl. No.	Zone/Farm (Product)	Proposed Capacity till 1993 000' Nutrient Tonnes	Anticipated Capacity in 1997 000' Nutrient Tonnes
	(a) Nitrogenous		
1.	Punjab Rice Zone		
1.1	Dawood	161 (351)	
2.	Punjab Cotton Zone		
2.1	FFC Optimization (Urea)	32 (70)	
2.2	FFC - II (Urea)	292 (635)	
3.	Sind Cotton Zone		
3.1	Exxon (Urea)	126 (275)	
3.2	NFC PS Optimization (Urea)	64 (139)	
4.	Sind Rice	-	
5.	NWFP	-	
	(b) Phosphatic		
1.	Punjab Rice	Nil	
2.	Punjab Cotton	Nil	
3.	Punjab Sugarcane	Nil	
4.	Sind Cotton		
4.1	MFC Sind (SSP)	14 (90)	
5.	NWFP		
5.1	NFC Attock (SSP)	14 (90)	
5.2	NWFP (SSP)	14 (90)	
6.	Balochistan		
6.1		14 (90)	

Source: RONCO/ACSCA Fertilizer and Pesticides Agro-Industry Research Report, Volume 1: The Fertilizer Sub-Sector 1990 (Appendix)

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Table - 3. Estimates of Fertilizer Production Consumption and Imports in Pakistan 1986-87 and 1987-88

Fertilizer Category	1986-87 ('000' Nutrients Tonnes)			1987-88 ('000' Nutrient Tonnes)		
	Consumption	Production	Imports*	Consumption	Production	Imports*
Nitrogen (H)	1332.4	1190.0	135.3	1281.7	1097.0	200.6
Phosphate (P)	408.8	93.0	340.8	393.4	96.0	264.4
Potash (k)	42.6	Nil	46.3	45.1	0.0	57.0
Total	1783.8	1212.0	522.4	1720.2	1193.0	521.6

Source: Agricultural Statistics of Pakistan 1989-90 [2]

* Imports figures are not the difference between consumption (C) and production (PR). Any difference in C and PR not reflected in imports may have been adjusted in stock-in-hand.

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Table 4. Retail Sales Prices and Import Prices of Fertilizers in Pakistan, 1986-87 and 1987-88

Fertilizer	1986-87 Rupees/Actual Tonne		1987-88 Rupees/Actual Tonne	
	Retail Price	Import Price	Retail Price	Import Price
Nitrogen (46 Nut) (N) 46 Nut)	2560	3251	2560	3940
Phosphate (SSP) (18 Nut.)	800	1067	860	1410
Potash (SOP) 50 K or 0.20N	1200	1499	1440	2051
DAP	3220	NA	3700	NA

Source: Estimates based on data from the Economic Survey of Pakistan 1989-90.

* Strictly speaking retail prices and import prices are not for the same varieties of fertilizers. Whereas import prices are for nutrient varieties i.e. N, P, and K, retail prices are for Urea (N), SSP (P) and SOP (K). Calculation of import prices for compound fertilizers was also possible from the given data but was not attempted as the model (PASM) requires prices for nutrient units only. This also explains why import prices for DAP has not been reported here.

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Table 5 -Total Subsidy on Imports of Chemical Fertilizer by Variety, Pakistan, 1986-89 and 1987-88.

S. No.	Fertilizer (Nutrient Content)	1986-87 (Rupees Million)	1987-88
1.	Nitrogen (N)	229.10	687.76
2.	Phosphate (P)	576.76	923.05
3.	Potash (K)	78.73	199.09
4.	DAP	NA	NA

Source: Estimated based on data from Agricultural Statistics of Pakistan [2].
NA: Estimate in this table are for nutrient units and not for the compound fertiliz varieties.

Table 6 - Inter-Zones and Intra-Zone Transport and Handling Costs of Fertilizers in Pakistan, 1987-88

Sl. No.	Inter-Zone	Nitrogenous (Rs./	Phosphatic Nut. tonnes)
1.	Cotton Punjab to Rice Punjab (Multan to Lahore)	491	982
2.	Cotton Punjab to Sugarcane Punjab (Multan to Faisalabad)	413	826
3.	Cotton Punjab to Cotton Sind (Multan to Sukkur)	370	740
4.	Cotton Punjab to Rice Sind (Multan to Karachi)	630	1260
5.	Cotton Punjab to Balochistan (Multan to Quetta)	652	1304
6.	Cotton Punjab to NWFP (Multan to Peshawar)	609	1218
7.	Cotton Sind to Rice Sind (Sukkur to Karachi)	370	740
8.	Cotton Sind to Balochistan (Sukkur to Quetta)	391	782

contd..

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Sl. No.	Inter-Zone	Nitrogenous (Rs./	Phosphatic Nut. tonnes)
9.	Rice Punjab to Rice Sind (Lahore to Karachi)	815	1630
10.	Rice Punjab to Cotton Sind (Lahore to Sukkur)	696	1392
11.	Rice Punjab to Sugarcane Punjab (Lahore to Faisalabad)	408	816
12.	Rice Punjab to Balochistan (Lahore to Quetta)	815	1630
13.	Rice Punjab to NWFP (Lahore to Peshawar)	570	1140
14.	Sugarcane Punjab to Rice Sind (Faisalabad to Karachi)	804	1608
15.	Sugarcane Punjab to Cotton Sind (Faisalabad to Sukkur)	630	1260
16.	Sugarcane Punjab to Balochistan (Faisalabad to Quetta)	804	1608
17.	Sugarcane Punjab to NWFP (Faisalabad to Peshawar)	630	1260
18.	Rice Sind to Balochistan (Faisalabad to Quetta)	491	982
19.	Rice Sind to NWFP (Karachi to Peshawar)	913	1826
20.	Balochistan to NWFP (Quetta to Peshawar)	870	1740
	(b) INTRA-ZONE		
1.	Within Cotton Zone Punjab (Multan to R.Y. Khan)	435	870
2.	Within Rice Punjab Zone (Lahore to Sialkot)	348	696
3.	Within Sugarcane Punjab (Faisalabad to Sargodha)	261	522
4.	Within Sind Cotton (Sukkur to Hyderabad)	326	652
5.	Within Sind Rice (Karachi to Larkana)	435	870
6.	Within NWFP (Abbottabad to Peshawar)	326	652
7.	Within Balochistan (Quetta to Nasirabad)	435	870

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Source: Based on information take from various marketing studies. The costs include:

(a) Trucking charges
(b) Loading and unloading charges
(c) Octroi (toll tax), district taxes on the way, losses and miscellaneous charges.

It is assumed that one truck carries 12 tonnes load containing about 240 bags of 50 kg of fertilizer Using costs for the actual weight, data for nutrient tonnage were converted as follows:

For N = (Transport & handling 'cost for the actual weight') x 1/.46
For P = (Cost of actual weight) x 1/.23

Since actual weight has different nutrient content in different fertilizers, the cost of nutrient tonne is going to differ by varieties. This explains the difference in rates for N and P.

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V. RESULTS OF THE SIMULATION EXERCISES

In this section the results of the simulations are reported. In the first part the results of several comparative statistics "experiments" are given. First, the prices of fertilizer were increased by 25 percent to see the independent effects of that factor of production. (All three types of fertilizer in the model, nitrogen, potash, and phosphate, were increased by the same percentages.) The second simulation involved decreasing the price by 25 percent. Finally, the quantities of fertilizer were increased by 25 percent. The second set of simulations involve utilizing a projection for ten years past the base model, until 1997/98, to see what kind of supply might be required based on certain assumptions of the forecast. A third set of possible simulations that could be carried, perhaps the most interesting from the perspective of agribusiness, are also described in this report.

The latter simulations involve specifying the fertilizer industry in detail to show the "free-market" prices when certain capacities are put into different zones in the model and when distribution subsidies are lifted. This requires detailed information on the capacity and costs of each firm in the industry, which has been presented in the earlier part of this report. It also involves a more intricate specification within the model. As such, it can be done independently for nitrogen and phosphate.

5.1 COMPARATIVE STATISTICS EXPERIMENTS: CHANGING THE PRICES AND QUANTITIES OF FERTILIZER

One of the main questions regarding the fertilizer industry in Pakistan is the effects on agriculture if privatization occurs. If oligopolistic behavior dominates, prices would increase and perhaps quantities would be restricted. On the other hand, adequate profits in that type of industry might bring more than adequate capacity, but with high prices. Thus it is of consequence to know the anticipated results from changes in relative prices and fertilizer availabilities. The easiest way to accomplish this is to look at each effect individually so that relative importance can be assessed. This is done below first for price and then for quantity changes.

5.1.1 Raising and Lowering Fertilizer Prices by 25 Percent. Prices were increased by 25 percent for all three types of fertilizer to see the impact. The impact was clear: no change occurred in the optimal solution from raising fertilizer prices. The implication is of course that the fertilizer supply elasticity is quite low. Part of the reason is that fertilizer costs are not significant enough (at about 5.5% of total costs on average) to materially affect the decision of producers. It appears that those crops which make the most intensive use of fertilizer are profitable enough to absorb the increased costs of fertilizer.

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Table 7: PASM National Acreage Values

Simulation Assumptions: Fertilizer Prices Down 25%

('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated/ Actual
KHARIF:			
Basmati Rice	916.3	966.2	105.4
Other Rice	1127.7	1174.3	104.1
Coarse Grains	1740.4	1471.3	84.5
Cotton	2567.7	2502.1	97.4
Sugarcane	842.0	759.1	90.1
Trad. Oilseeds	156.7	160.0	102.1
Non-Trad. Oilseed	6.6	28.3	428.6
Pulses	215.5	215.0	99.8
Vegetables	219.7	243.0	110.6
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	8608.2	96.9
RABI:			
Wheat	7724.8	7461.7	96.6
Barley	152.7	0.0	0.0
Pulses	1052.0	1602.5	152.3
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	280.0	100.2
Non-Trad. Oilseed	21.7	21.7	100.0
Rabi Fodder	1293.9	1172.6	90.6
Fruit	415.6	390.4	93.9
	11130.9	10928.9	98.2

Sources: Actual Values, EAN Farm Income Estimates

This is not an unambiguous gain however because the increased price implies a transfer out of agriculture to fertilizer companies, with possible dynamic consequences. This has not been tabulated but the model provides adequate information to estimate quantitatively what the transfer would be.

The response to changes in fertilizer prices is not symmetric because some change in the optimal

solution arises when the prices are decreased. These are given in the Table 7 above. No crop changed more than a few percent. More basmati rice and slightly less other rice is grown compared to the base solution, suggesting that costs of fertilizer would permit some lower quality land to become more attractive for basmati growing. There is also a very slight increase in the other main crops, cotton and sugarcane, but wheat decreases about a half percent from the base. This probably comes from the advantage of growing more cotton and basmati, which displace some wheat and make pulses more competitive because they compete with late wheat in some areas. Overall though, the changes are modest and the basmati change may be overstated because of the downward sloping demand curve.

In contrast, availability makes a great impact, almost startlingly so. The effect of adding 20 percent additional fertilizer are given in the next simulation, which is shown in Table 8 below. More basmati is grown relative to other rice, in quite large proportions. Basmati is grown on six percent more acreage than in the base solution while other rice drops about the same amount. The rest of the major crops are all grown on more acreage as well, but the changes are not as great. Overall more acreage is brought into production as well, indicating that at least in some areas the lack of fertilizer is limiting production. Also there are some surprising results among the smaller crops. Fruit is grown on about four percent more acreage than in the base solution but vegetables are not grown as much despite a greater availability of fertilizer (although higher yielding choices may be used).

More information can be derived from the simulations about each of these results. The importance of increased quantities of fertilizer clearly can be specific to the location and type of fertilizer in question. Much information can be obtained from the dual values and the excess quantities of fertilizer in different areas. These simple experiments appear to suggest a case of encouraging private investment in fertilizer. Price increases do not seem to change the output of agriculture, albeit they do reduce profits. Since the government cannot keep pace with expensive needed capacity. The only alternative may be to provide a good investment climate. If prices are too high the impact will be less than if there is not enough quantity.

Table 8: PASM National Acreage Values

Simulation Assumptions: Fertilizer Quantities Up 20%

('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated/ Actual
KHARIF:			
Basmati Rice	916.3	1013.9	110.7
Other Rice	1127.7	1130.5	100.3
Coarse Grains	1740.4	1595.3	91.7
Cotton	2567.7	2520.4	98.2
Sugarcane	842.0	798.5	94.8
Trad. Oilseeds	156.7	160.0	102.1
Non-Trad. Oilseed	6.6	28.3	428.6
Pulses	215.5	215.0	99.8
Vegetables	219.7	223.9	101.9
Kharif Fodder	1088.6	1089.0	100.0
	8881.3	8774.8	98.8
RABI:			
Wheat	7724.8	7675.4	99.4
Barley	152.7	0.0	0.0
Pulses	1052.0	1353.5	128.7
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	280.0	100.2
Non-Trad. Oilseed	21.7	21.7	100.0
Rabi Fodder	1293.9	1182.0	91.4
Fruit	415.6	371.6	89.4
	11130.9	10884.1	97.8

Sources: Actual Values, EAN Farm Income Estimates

5.2 FERTILIZER DEMAND IN 1997: USING PASM FOR PROJECTIONS

The demand for fertilizer will certainly continue to grow during the next decade and most of the capacity is planned. PASM can be used to examine the required fertilizer capacity by making projections that contain considerable detail about changes in technologies, the prevalence of various resources, and the likely changes in patterns of demand. In this section one projection which has been made is outlined and the results are discussed. At this point assumptions about fertilizer change are fairly simple -- we just assumed a doubling of availabilities and did not discriminate between imports or local capacity. Nor was the location of capacity taken into account or the results of the changes in polices regarding subsidies on distribution. In this section the basis for the projections is discussed and the results of a "base" projection model are given.

5.2.1 Assumptions of the Projections. The major assumptions used to project the PASM model to 1997 are given in Tables 9 and 10. As in any projection there are demand and supply side factors involved. The basic premise was that the sector was likely to face tight conditions -- a low growth in land availability combined with a large increase in demand from rising incomes and population. Rather than trying to get the model to solve when there were tight resource constraints we chose scenarios which were advantageous to help make the sector meet its requirements. This means that yields would continue to grow at historical rates or better, water availability would continue to improve relative to cropped acreage and there would be less pressure to meet livestock demands than in the original model. Since demand is not the main concern in getting a feasible solution it was assumed to grow at historical levels, so that the scenario has relatively high growth in demand but where resources grow only moderately.

The specific growth rates in the major resources are included in Table 9, where the annual rates are given. Yields grow at the rate seen from 1984/85 to 1989/90, a range of years which gave favorable growth rates compared to other recent five-year periods. Fertilizer growth rates were assumed to be 3.5% per year for all crops. Thus the relative use of fertilizer stayed the same as in 1987/88 but the use increased per hectare fairly substantially. With wide variations in yields, there is a declining benefit from fertilizer for many crops (rice especially) being assumed in the projections. These assumptions may appear rough but serve to show the types of information which must be used in these projections.

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TABLE 9

ASSUMED GROWTH RATES FOR PASM PROJECTIONS

	Category	Assumptions
1	Yield Increases	1984/85 - 1989/90 % change
2	Fertilizer Use	3.5% per annum
3	Cropped Area	1.4 % Per annum
4	Water Availability	1.8% Per annum
5	Hired Labor	3.0% Per annum
6	Family Labor	Punjab - 2.1% Sind - 2.6% Balochistan - 6.8% NWFP - 3.0%
7	All Livestock	1.8% per annum
8	Output Prices	10% over ten years
9	Imports	30% over ten years
10	Exports	20% over ten years

TABLE 10

INCOME AND POPULATION GROWTH RATES AND INCOME ELASTICITIES

FOR

1997/98 PASM PROJECTIONS

	Income Elasticity	Income Change (% p.a)	Population Change (% p.a)
Basmati Rice	0.75	2.0	3.0
Other Rice	0.75	2.0	3.0
Sugar	0.65	2.0	3.0
Pulses	0.35	2.0	3.0
Wheat	0.23	2.0	3.0
Vegetables	1.0	2.0	3.0
Fruit	1.0	2.0	3.0
Edible Oil	0.8	2.0	3.0
Cotton	0.74	2.0	3.0
Liquid Oil	0.8	2.0	3.0
Coarse Grain	.35	2.0	3.0
Beef	1.3	2.0	3.0
Mutton	1.3	2.0	3.0
Poultry	1.3	2.0	3.0
Eggs	1.3	2.0	3.0
Milk	0.8	2.0	3.0
Butter	0.8	2.0	3.0
Animal Ghee	0.8	2.0	3.0

Livestock is projected to increase relatively slowly but average yields from the herds are assumed to grow around 5-6 percent for most products so that demand can be met even with slow growth in herd numbers. Also the output of meat and milk grew rapidly but inputs required in the rations did not, again making it easier to meet the restrictions. Income was estimated to continue to grow on a per capita basis around 2 percent and population is expected to continue to grow at 3 percent, both of which are indicated in Table 10. The income elasticities are also presented.

5.2.2 Results of the Projection Model. The results were somewhat hard to predict, but in retrospect differences in yield growth and the assumptions of growth in international markets determined much of the major results, If a crop maintained its position relative to 1987/88, it would have about 15 percent difference between the base solution and the projection, because the projection assumes a growth in cropped area of about that amount over the ten year period. Wheat and sugarcane appeared to maintain their relative positions based on this criteria. Coarse grains lost some ground, perhaps due to the slow growth projected in livestock numbers. Basmati rice and other rice gained proportionally quite a lot, and cotton lost ground considerably. This was due to the fact that cotton yields grow over fifty percent during the ten year period but the export market, on which it is highly dependent, grew relatively less. Therefore, there was little reason to continue to grow cotton in this scenario. On other hand, the stagnating yields in rice, in combination with the low opportunity for selling cotton, put more acreage into those crops. This might then show the low trade scenario with a high growth in the productivity of cotton.

The above discussion shows that the nature of projections can be revised extensively. The ones presented here are really starting points for discussion and revisions, and are by no means final versions. However, they do indicate some things about fertilizer: At real prices of 1987/88, doubling the availability would make for an adequate provision in ten years. Given that, urea should increase by 50 percent by 1993 and phosphate by 60 percent this capacity should be close to enough to meet the needs, although some extra capacity will be needed beyond what is planned to reduce dependence on imports. A substantial amount of continued intensification of fertilizer use was also assumed in this scenario so that projections of demand may not be on the low side.

Table 11: PASM National Acreage Values

Simulation Assumptions: Base Projection Results

('000 Hectares)

Crop	1987/88 Actual	Simulated Results	% Simulated/ Actual
Kharif:			
Basmati Rice	916.3	1441.8	157.4
Other Rice	1127.7	1621.7	143.8
Coarse Grains	1740.4	1681.9	96.6
Cotton	2567.7	1966.0	76.6
Sugarcane	842.0	863.1	102.5
Trad. Oilseeds	156.7	176.0	112.3
Non-Trad. Oilseed	6.6	31.1	471.4
Pulses	215.5	236.5	109.7
Vegetables	219.7	266.7	121.4
Kharif Fodder	1088.6	1197.9	110.0
	8881.3	9482.8	106.8
Rabi:			
Wheat	7724.8	8589.2	111.2
Barley	152.7	297.7	194.9
Pulses	1052.0	1789.1	170.1
Rabi Vegetables	190.9	0.0	0.0
Trad. Oilseeds	279.3	308.0	110.3
Non-Trad. Oilseed	21.7	23.9	110.0
Rabi Fodder	1293.9	1201.9	92.9
Fruit	415.6	490.9	118.1
	11130.9	12700.6	114.1

Sources: Actual Values, EAN Farm Income Estimates

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VI. SIMULATING FIRM LEVEL RESPONSES

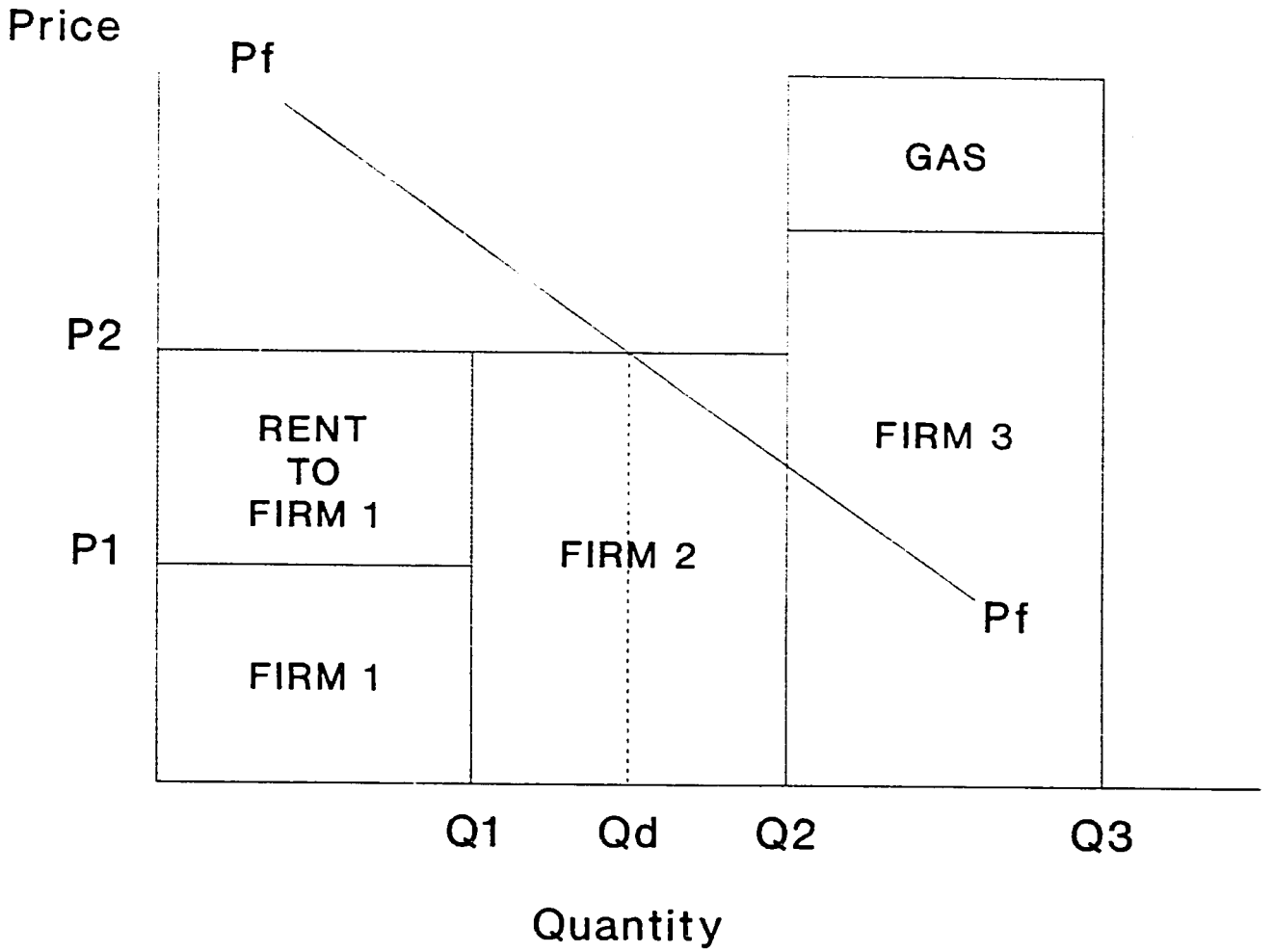
From an agribusiness point of view, perhaps the most intriguing simulations which can be done are in analyzing the location and pricing at a firm level within the model. That essentially amounts to placing a transshipment model within the sector model to account for location, local demand and the resulting pattern of trade among different regions. The idea would be to build an upward sloping supply curve for each type of fertilizer in each zone. The general idea is contained in the attached figure, which shows a supply curve for fertilizer. Firm 1 would be the most efficient firm, as it would be wiling to supply its product at the lowest price. That would bring in fertilizer supplies up to Q1. Beyond that the price would have to rise to P2 to get production from the second fertilizer firm. As the market price increases to P2 the first firm earns a rent on its production amounting to the area shaded in gray.

It should be evident from earlier discussions that the type of data which we have collected can be used in this analysis. Furthermore, not all zones will be self-sufficient, so that there needs to be trade among zones. The data earlier has shown a range of transport costs between different zones, which can be significant. This formulation will end up showing what is shipped to each area, and how much is consumed within the locality. This is of course done for all types of fertilizers. Furthermore, the different inputs to each fertilizer firm can also be included in the analysis, which is also illustrated in the figure for natural gas inputs. Some portion of the costs of each firm (and it will vary by firm) is made up of natural gas costs. These can be separated out of the costs and priced independently. This would provide a handle to investigate the impacts of changes farther down the input supply chain, but for ones which may consequential.

This construction can present a framework for analyzing a variety of policy, spatial and agribusiness issues. Changes can be made in the capacity which exists at different costs as a proxy for changes in behavior of the industry. If the industry colludes, then there will be a large amount of high cost capacity and the pattern of prices and movements of fertilizer will change. With competition it can be assumed that the low cost producer will become more prevalent. Also, changing transport costs and relative efficiencies of firms in different areas can show the changing consequences of the distribution subsidy on shipping fertilizer. With transport costs being up to one fifth of total costs this is not insignificant. Finally, the implications of changes in import prices on the profitability of firms in different regions can be investigated to determine the extent to which natural protection can keep relatively inefficient producers in business. These are some of the issues which can become part of the agenda for future research on this subject.

Figure 1

HYPOTHETICAL ZONAL FERTILIZER SUPPLY FUNCTION



A SIMULATION STUDY OF THE FERTILIZER INDUSTRY IN PAKISTAN

APPENDIX-1

FERTILIZER USE, YIELDS AND YIELD/FERTILIZER RATIOS BY CROP AND ZONE IN PAKISTAN, 1987-88

Appendix-1

Fertilizer Use, Yields, and Yield/Fertilizer Ratios by Crop and Zone in Pakistan, 1987-88

Rice Basmati

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	68.4	41.2	60.7	972	1024	1018	14.2	24.9	16.8
	2	35.3	54.9	76.3	947	998	993	26.9	18.2	13.0
	3	33.0	43.0	36.3	1069	1126	1121	32.4	26.2	30.9
	4	0.0	0.0	0.0				NA	NA	NA
	5	0.0	0.0	0.0				NA	NA	NA
	6	19.8	19.8	19.8	1530	1610	1602	77.1	81.2	80.7
	7	89.3	53.8	79.2	1043	1095	1095	11.7	20.4	13.8
	8	46.9	61.0	51.5	1451	1527	1519	31.0	25.0	29.5
PHO										
	1	16.7	7.7	14.0	972	1024	1018	58.3	132.9	72.7
	2	1.5	13.6	10.9	947	998	993	642.8	73.6	91.0
	3	3.6	8.4	6.8	1069	1126	1121	299.7	134.0	165.0
	4							NA	NA	NA
	5							NA	NA	NA
	6	8.4	8.4	8.4	1530	1610	1602	182.0	191.5	190.5
	7	36.7	17.0	30.9	1043	1095	1095	28.4	64.5	35.5
	8	6.1	14.3	11.5	1451	1527	1519	239.6	107.0	131.8
POT.										
	1			7.6	972	1024	1018	NA	NA	134.1
	2		6.7		947	998	993	NA	149.4	NA
	3		67.4		1069	1126	1121	NA	16.7	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6				1530	1610	1602	NA	NA	NA
	7			19.1	1043	1095	1095	NA	NA	57.4
	8	5.9	8.8	14.7	1451	1527	1519	247.5	173.4	103.4

NA: Absence of relevant data does not allow the estimation of this ratio.
PHO: Phosphate
FOT: Potash

1= Punjab Rice
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3= Punjab Cotton
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5= Sind Cotton
6= Balochistan
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8= NWFP Unirrigated

K H A R I F C R O P

Rice Other

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	44.4	21.0	68.3	2113	2223	2211	47.6	105.8	32.4
	2	38.4	38.4	38.4	2203	2318	2307	57.4	60.4	60.1
	3	33.2	0.0	33.2	1714	1803	1794	51.6	NA	54.0
	4	20.5	9.7	31.6	2411	2537	2525	117.4	261.0	79.9
	5	28.9	0.0	28.9	1460	1536	1528	50.5	NA	52.9
	6	23.1	23.1	28.9	3553	3739	3720	153.9	162.0	128.9
	7	57.9	27.4	89.2	3965	4164	4164	68.4	151.8	46.7
	8	47.1	0.0	47.1	2168	2277	2277	46.0	NA	48.3
PHO										
	1	9.9	4.1	12.4	2113	2223	2211	212.6	536.7	178.0
	2	6.8	6.8	6.8	2203	2318	2307	325.0	342.0	340.3
	3	5.4	0.0	5.4	1714	1803	1794	318.6	NA	333.5
	4	7.7	3.2	9.7	2411	2537	2525	311.9	787.8	261.4
	5	7.8		7.8	1460	1536	1528	188.4	NA	197.2
	6	16.8	16.8	0.0	3553	3739	3720	211.3	222.3	NA
	7	21.9	9.1	27.4	3965	4164	4164	181.0	456.2	152.1
	8	9.1	0.0	9.1	2168	2277	2277	237.5	NA	249.4
POT.										
	1			5.8	2113	2223	2211	NA	NA	378.4
	2	6.2	6.2	6.2	2203	2318	2307	353.7	372.2	370.3
	3	16.9		16.9	1714	1803	1794	101.7	NA	106.4
	4			5.4	2411	2537	2525	NA	NA	471.0
	5	27.8		27.8	1460	1536	1528	52.5	NA	55.0
	6				3553	3739	3720	NA	NA	NA
	7			14.7	3965	4164	4164	NA	NA	283.6
	8	4.4	3.7	3.7	2168	2277	2277	489.9	620.7	620.7

1= Punjab Rice
2= Punjab Sugarcane
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8= NWFP Unirrigated

K H A R I F C R O P

Maize

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	26.9	26.9	26.9	474	556	493	17.6	20.7	18.3
	2	44.7	56.3	60.7	874	918	909	19.6	16.3	15.0
	3	55.5	99.6	38.6	662	695	689	11.9	7.0	17.8
	4	12.5	12.5	12.5	307	314	321	24.6	25.2	25.8
	5	48.3	86.7	33.6	359	378	376	7.4	4.4	11.2
	6	11.2	12.0	15.4	408	518	513	36.5	43.1	33.3
	7	42.0	42.0	42.0	1684	1767	1751	40.1	42.1	41.7
	8	27.4	27.4	27.4	706	741	734	25.7	27.0	26.8
PHO										
	1	12.4	12.4	12.4	474	556	493	38.1	44.7	39.7
	2	13.6	14.0	13.6	874	918	909	64.5	65.7	67.1
	3	10.8	16.1	10.8	662	695	689	61.6	43.1	64.0
	4	9.7	9.7	9.7	307	314	321	31.7	32.5	33.2
	5	15.5	23.2	15.5	359	378	376	23.2	16.2	24.3
	6	4.3	1.0	5.0	408	518	513	94.6	520.4	102.8
	7	10.3	10.3	10.3	1684	1767	1751	163.2	171.3	169.7
	8	9.1	9.1	9.1	706	741	734	77.3	81.2	80.4
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

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K H A R I F C R O P

Cotton-3-picking

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	59.9	59.9	59.9	164	162	175	2.7	2.7	2.9
	2	57.7	85.9	100.6	284	281	303	4.9	3.3	3.0
	3	74.4	89.2	103.4	768	760	820	10.3	8.5	7.9
	4	27.2	27.2	27.2	199	193	189	7.3	7.1	7.0
	5	63.2	75.7	88.8	358	348	340	5.7	4.6	3.8
	6							NA	NA	NA
	7	82.3	82.3	82.3	200	198	214	2.4	2.4	2.6
	8	82.3	82.3	82.3	32	32	34	0.4	0.4	0.4
PHO										
	1	11.8	11.8	11.8	164	162	175	13.9	13.7	14.8
	2	19.3	24.0	24.1	284	281	303	14.7	11.7	12.6
	3	20.4	18.9	21.4	768	760	820	37.6	40.2	38.4
	4	10.7	8.6	8.7	199	193	189	18.7	22.4	21.8
	5	28.0	26.7	28.4	358	348	340	12.8	13.0	12.0
	6							NA	NA	NA
	7	27.4	27.4	27.4	200	198	214	7.3	7.2	7.8
	8	27.4	27.4	27.4	32	32	34	1.2	1.2	1.2
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

1= Punjab Rice
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K H A R I F C R O P

Cotton-4-picking

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	65.8	65.8	65.8	180	178	192	2.7	2.7	2.9
	2	63.5	94.5	110.7	312	309	333	4.9	3.3	3.0
	3	81.9	98.1	113.8	845	836	902	10.3	8.5	7.9
	4	31.2	31.2	31.7	219	212	208	7.0	6.8	6.6
	5	73.2	87.7	100.8	394	382	374	5.4	4.4	3.7
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA
PHO										
	1	13.0	13.0	13.0	180	178	192	13.9	13.7	14.8
	2	21.3	26.4	26.5	312	309	333	14.7	11.7	12.6
	3	22.5	20.8	23.5	845	836	902	37.6	40.2	38.4
	4	8.7	10.7	10.7	219	212	208	25.3	19.9	19.5
	5	34.0	30.7	36.4	394	382	374	11.6	12.5	10.3
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

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K H A R I F C R O P

Sugarcane

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	24.9	57.1	50.9	34280	35531	34533	1376.7	622.3	679.1
	2	44.7	97.2	101.1	38716	40129	39002	866.6	412.7	385.7
	3	87.2	124.5	177.5	32280	32280	32518	370.2	259.4	183.2
	4	11.5	26.4	23.5	44662	44226	47712	3876.9	1674.0	2027.7
	5	75.9	108.3	154.5	44855	44417	47918	590.8	410.1	310.1
	6	13.7	31.4	27.9	54054	54054	54054	3950.3	1722.7	1934.4
	7	74.6	74.6	74.6	41345	43000	41759	554.5	576.7	560.0
	8	74.6	74.6	74.6	30208	31417	30511	405.1	421.3	409.2
PHO										
	1	6.9	8.3	13.0	34280	35531	34533	4985.6	4289.1	2655.2
	2	13.6	28.7	29.3	38716	40129	39002	2855.7	1396.2	1331.9
	3	21.5	25.1	10.8	32280	32280	32518	1500.5	1288.0	3023.1
	4	5.4	6.4	10.1	44662	44226	47712	8348.0	6867.4	4714.6
	5	31.0	36.1	15.5	44855	44417	47918	1447.4	1230.4	3093.5
	6	14.0	16.8	26.4	54054	54054	54054	3872.4	3214.1	2047.2
	7	17.2	17.2	17.2	41345	43000	41759	2400.8	2496.9	2424.8
	8	17.2	17.2	17.2	30208	31417	30511	1754.1	1824.3	1771.7
POT.										
	1		11.7		34280	35531	34533	NA	3040.3	NA
	2		24.9		38716	40129	39002	NA	1610.4	NA
	3				32280	32280	32518	NA	NA	NA
	4		10.7		44662	44226	47712	NA	4125.6	NA
	5				44855	44417	47918	NA	NA	NA
	6	1.8	4.4	2.6	54054	54054	54054	30712.5	12285.0	20475.0
	7				41345	43000	41759	NA	NA	NA
	8	17.6		17.6	30208	31417	30511	1715.4	NA	1732.6

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K H A R I F C R O P

Oilseed-t

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	5.9	5.9	5.9	415	319	507	70.2	54.0	85.8
	2	6.3	6.3	6.3	885	681	681	140.9	108.4	108.4
	3	5.4	5.4	5.4	888	683	1085	163.4	125.7	199.7
	4	2.7	2.7	2.7	367	380	370	134.4	139.3	135.4
	5	4.7	4.7	4.7	1571	1628	1582	332.1	344.2	334.6
	6	3.2	3.2	3.2	396	305	484	122.1	93.9	149.3
	7	7.7	7.7	7.7	1253	1303	1265	162.4	168.8	163.9
	8	7.7	7.7	7.7	572	595	578	74.1	77.1	74.9
PHO										
	1	4.1	4.1	4.1	415	319	507	100.1	77.0	122.4
	2	6.8	6.8	6.8	885	681	681	130.6	100.5	100.5
	3	5.4	5.4	5.4	888	683	1085	165.0	126.9	201.7
	4	3.2	3.2	3.2	367	380	370	114.0	118.1	114.8
	5	7.8	7.8	7.8	1571	1628	1582	202.7	210.1	204.2
	6	8.4	8.4	8.4	396	305	484	47.1	36.3	57.6
	7	9.1	9.1	9.1	1253	1303	1265	137.3	142.8	138.6
	8	9.1	9.1	9.1	572	595	578	62.7	65.2	63.3
POT.										
	1	2.9	2.9	2.9				0.0	0.0	0.0
	2	12.5	12.5	12.5				0.0	0.0	0.0
	3	33.7	33.7	33.7				0.0	0.0	0.0
	4	2.7	2.7	2.7				0.0	0.0	0.0
	5	5.6	5.6	5.6				0.0	0.0	0.0
	6	1.1	1.1	1.1				0.0	0.0	0.0
	7	7.3	7.3	7.3				0.0	0.0	0.0
	8	7.3	7.3	7.3				0.0	0.0	0.0

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K H A R I F C R O P

Oilseed-nt

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	45.9	45.9	45.9	1098	845	1342	23.9	18.4	29.2
	2	48.9	48.9	48.9	1251	962	962	25.6	19.7	19.7
	3	42.8	42.3	42.3	998	768	1219	23.3	18.2	28.9
	4	6.1	6.1	6.1	617	639	621	101.6	105.3	102.4
	5	21.0	21.0	21.0	615	637	619	29.2	30.3	29.5
	6							NA	NA	NA
	7	60.0	60.0	60.0	683	649	614	11.4	10.8	10.2
	8	30.0	30.0	30.0	1083	833	1324	36.1	27.8	44.1
PHO										
	1	9.0	9.0	9.0	1098	845	1342	121.9	93.8	149.0
	2	14.7	14.7	14.7	1251	962	962	84.9	65.3	65.3
	3	11.7	11.7	11.7	998	768	1219	85.3	65.6	104.3
	4				617	639	621	NA	NA	NA
	5	10.8	10.8	10.8	615	637	619	57.0	59.1	57.4
	6							NA	NA	NA
	7	19.8	19.8	19.8	683	649	614	34.4	32.7	30.9
	8	9.9	9.9	9.9	1083	833	1324	109.1	84.0	133.4
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6							NA	NA	NA
	7							NA	NA	NA
	8							NA	NA	NA

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K H A R I F C R O P

Vegetables

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	162.8	162.8	162.8	16697	15398	12398	102.6	94.6	76.2
	2	173.1	173.1	173.1	16981	15659	12609	98.1	90.5	72.8
	3	149.7	149.7	149.7	14237	13129	10572	95.1	87.7	70.6
	4	75.3	75.3	75.3	3808	2930	4655	50.6	38.9	61.8
	5	130.3	130.3	130.3	1607	1236	1964	12.3	9.5	15.1
	6	89.4	89.4	89.4	13801	12726	10247	154.3	142.3	114.6
	7	212.6	212.6	212.6	17239	13273	15859	81.1	62.4	74.6
	8	212.6	212.6	212.6	14585	11231	13418	68.6	52.8	63.1
PHO										
	1	16.6	16.6	16.6	16697	15398	12398	1007.8	929.4	748.3
	2	27.1	27.1	27.1	16981	15659	12609	626.3	577.5	465.0
	3	21.5	21.5	21.5	14237	13129	10572	661.8	610.3	491.4
	4	12.9	12.9	12.9	3808	2930	4655	295.5	227.3	361.1
	5	31.0	31.0	31.0	1607	1236	1964	51.9	39.9	63.4
	6	33.6	33.6	33.6	13801	12726	10247	410.3	378.4	304.7
	7	36.5	36.5	36.5	17239	13273	15859	472.2	363.6	434.4
	8	36.5	36.5	36.5	14585	11231	13418	399.5	307.6	367.5
POT.										
	1	2.9	2.9		16697	15398	12398	5715.1	5270.2	NA
	2	12.5	12.5		16981	15659	12609	1362.9	1256.8	NA
	3	33.7	33.7		14237	13129	10572	422.3	389.4	NA
	4	2.7	2.7		3808	2930	4655	1421.1	1093.1	NA
	5	55.6	55.6		1607	1236	1964	28.9	22.2	NA
	6	1.1	1.1		13801	12726	10247	12546.1	11569.4	NA
	7	7.3	7.3	7.3	17239	13273	15859	2350.3	1809.6	2162.2
	8	7.3	7.3	7.3	14585	11231	13418	1988.5	1531.2	1829.3

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K H A R I F C R O P

Fodder

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	30.2	30.2	30.2						
	2	32.1	32.1	32.1						
	3	27.8	27.8	27.8						
	4	14.0	14.0	14.0						
	5	24.2	24.2	24.2						
	6	8.3	8.3	8.3						
	7	39.4	39.4	39.4						
	8	39.4	39.4	39.4						
PHO										
	1	3.6	3.6	3.6						
	2	5.9	5.9	5.9						
	3	4.7	4.7	4.7						
	4	2.8	2.8	2.8						
	5	6.7	6.7	6.7						
	6	7.3	7.3	7.3						
	7	7.9	7.9	7.9						
	8	7.9	7.9	7.9						
POT.										
	1	0.5	0.5	0.5						
	2	2.0	2.0	2.0						
	3	5.4	5.4	5.4						
	4	0.4	0.4	0.4						
	5	8.9	8.9	8.9						
	6	0.2	0.2	0.2						
	7	1.2	1.2	1.2						
	8	1.2	1.2	1.2						

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K H A R I F C R O P

Fruit

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	56.3	56.3	56.3	7404	7331	7909	131.4	130.1	140.4
	2	56.0	56.0	56.0	8735	8649	9331	156.0	154.5	166.7
	3	61.6	61.6	61.6	7906	7829	8446	128.3	127.0	137.0
	4	21.8	21.8	21.8	8138	7731	7324	373.3	354.6	336.0
	5	21.8	21.8	21.8	7975	7576	7177	365.8	347.5	329.2
	6	53.9	53.9	53.9	12960	12833	13845	240.4	238.0	256.8
	7	128.1	128.1	128.1	10249	10761	10659	80.0	84.0	83.2
	8	128.1	128.1	128.1	10901	11446	11337	85.1	89.3	88.5
PHO										
	1	23.1	23.1	23.1	7404	7331	7909	320.8	317.7	342.7
	2	23.0	23.0	23.0	8735	8649	9331	379.4	375.7	405.3
	3	23.4	23.4	23.4	7906	7829	8446	337.9	334.7	361.0
	4	6.7	6.4	6.4	8138	7731	7324	1207.4	1213.6	1149.8
	5	6.4	12.7	6.4	7975	7576	7177	1251.9	594.7	1126.7
	6	21.0	21.0	21.0	12960	12833	13845	616.2	610.2	658.3
	7	22.8	22.8	22.8	10249	10761	10659	449.1	471.6	467.1
	8	22.8	22.8	22.8	10901	11446	11337	477.7	501.6	496.8
POT.										
	1							NA	NA	NA
	2							NA	NA	NA
	3							NA	NA	NA
	4							NA	NA	NA
	5							NA	NA	NA
	6	2.2	2.2	2.2	12960	12833	13845	5890.8	5833.2	6293.1
	7	14.7	14.7	14.7	10249	10761	10659	698.7	733.6	726.6
	8	14.7	14.7	14.7	10901	11446	11337	743.1	780.3	772.8

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R A B I C R O P S

Wheat

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	51.1	50.4	57.8	1430	1445	1502	28.0	28.7	26.0
	2	35.5	75.6	67.9	1493	1510	1569	42.1	20.0	23.1
	3	79.2	96.8	99.0	1520	1537	1598	19.2	15.9	16.1
	4	232.9	229.8	262.1	1134	1148	1193	4.9	5.0	4.6
	5	117.7	146.2	149.6	1949	1970	2047	16.6	13.5	13.7
	6	12.1	12.1	12.1	1751	1769	1839	144.9	146.5	152.2
	7	21.8	31.4	53.0	1269	1283	1334	58.1	40.9	25.2
	8	22.8	23.2	23.2	731	739	768	32.1	31.9	33.2
PHO										
	1	19.6	18.7	22.2	1430	1445	1502	72.9	77.4	67.6
	2	14.5	32.1	27.4	1493	1510	1569	103.1	47.1	57.3
	3	33.5	28.1	33.2	1520	1537	1598	45.4	54.8	48.1
	4	58.0	58.7	69.9	1134	1148	1193	19.6	19.6	17.1
	5	27.5	24.2	28.3	1949	1970	2047	70.9	81.3	72.4
	6	5.9	5.9	5.9	1751	1769	1839	296.9	300.1	311.8
	7		7.8	10.1	1269	1283	1334	NA	163.6	132.2
	8	11.4	11.2	11.2	731	739	768	64.0	65.9	68.5
POT.										
	1			9.0	1430	1445	1502	NA	NA	166.6
	2		3.0	6.1	1493	151[illegible]	1569	NA	496.7	258.1
	3		6.7	3.3	1520	153[illegible]	1598	NA	230.8	479.8
	4			16.1	1134	1148	1193	NA	NA	74.0
	5		12.3	8.2	1949	1970	2047	NA	160.0	250.3
	6				1751	1769	1839	NA	NA	NA
	7				1269	1283	1334	NA	NA	NA
	8							NA	NA	NA

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R A B I C R O P S

Late Wheat

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	56.2	55.4	63.6	1358	1373	1427	24.2	24.8	22.4
	2	39.0	83.1	74.7	1419	1434	1491	36.3	17.3	20.0
	3	87.1	106.5	108.9	1444	1460	1518	16.6	13.7	13.9
	4	212.9	209.8	242.1	1078	1090	1311	5.1	5.2	5.4
	5	137.7	166.2	169.6	1851	1871	1945	13.4	11.3	11.5
	6	13.3	13.3	13.3	1925	1947	1747	144.9	146.5	131.5
	7	24.0	33.7	56.3	1039	1050	1092	43.2	31.2	19.4
	8	25.1	24.3	25.3	598	605	629	23.8	24.9	24.8
PHO										
	1	21.6	20.5	24.4	1358	1373	1427	63.0	66.9	58.4
	2	15.9	35.3	30.1	1419	1434	1491	89.1	40.7	49.5
	3	36.8	30.9	36.6	1444	1460	1518	39.2	47.3	41.5
	4	54.0	48.7	57.9	1078	1090	1311	20.0	22.4	22.7
	5	37.5	30.2	36.3	1851	1871	1945	49.4	61.9	53.6
	6	6.5	6.5	6.5	1925	1947	1747	296.8	300.1	269.3
	7		9.0	11.2	1039	1050	1092	NA	117.1	97.4
	8	12.6	12.3	12.3	598	605	629	47.6	49.0	51.0
POT.										
	1			9.9	1358	1373	1427	NA	NA	143.9
	2		3.3	6.7	1419	1434	1491	NA	428.9	222.9
	3		7.3	3.7	1444	1460	1518	NA	199.4	414.4
	4			14.1	1078	1090	1311	NA	NA	92.9
	5		16.3	6.2	1851	1871	1945	NA	114.7	315.7
	6				1925	1947	1747	NA	NA	NA
	7				1039	1050	1092	NA	NA	NA
	8				598	605	629	NA	NA	NA

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R A B I C R O P S

Barley

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	16.6	21.6	24.9	644	651	676	38.8	30.2	27.2
	2	11.1	13.3	14.5	666	673	700	59.9	50.5	48.4
	3	13.3	17.2	19.9	583	589	613	43.9	34.2	30.8
	4	68.7	89.3	103.0	358	362	376	5.2	4.1	3.7
	5	20.3	26.4	30.5	433	438	455	21.3	16.6	14.9
	6				756	764	794	NA	NA	NA
	7	10.0	13.0	15.0	711	719	747	71.3	55.5	49.9
	8				570	577	599	NA	NA	NA
PHO										
	1				644	651	676	NA	NA	NA
	2				666	673	700	NA	NA	NA
	3				583	589	613	NA	NA	NA
	4				358	362	376	NA	NA	NA
	5				433	438	455	NA	NA	NA
	6				756	764	794	NA	NA	NA
	7				711	719	747	NA	NA	NA
	8				570	577	599	NA	NA	NA
POT.										
	1				644	651	676	NA	NA	NA
	2				666	673	700	NA	NA	NA
	3				583	589	613	NA	NA	NA
	4				358	362	376	NA	NA	NA
	5				433	438	455	NA	NA	NA
	6				756	764	794	NA	NA	NA
	7				711	719	747	NA	NA	NA
	8				570	577	599	NA	NA	NA

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R A B I C R O P S

Rabi Pulses

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	7.5	7.5	7.5	278	281	292	37.2	37.6	39.1
	2	5.0	5.0	5.0	246	249	259	49.2	49.8	51.7
	3	6.0	6.0	6.0	272	275	286	45.5	46.0	47.8
	4	30.9	30.9	30.9	420	425	442	13.6	13.7	14.3
	5	9.2	9.2	9.2	464	469	488	50.7	51.3	53.3
	6		8.4	8.4	459	464	482	NA	55.3	57.5
	7	4.5	4.5	4.5	209	211	219	46.5	47.0	48.8
	8				114	115	120	NA	NA	NA
PHO										
	1	9.8	10.2	9.8	278	281	292	28.3	27.4	29.7
	2	7.6	7.6	7.6	246	249	259	32.3	32.7	34.0
	3	8.4	8.4	8.4	272	275	286	32.4	32.7	34.0
	4	26.9	26.9	26.9	420	425	442	15.7	15.8	16.4
	5	7.7	7.7	7.7	464	469	488	59.9	60.6	63.0
	6		2.9	2.9	459	464	482	NA	157.7	163.9
	7	5.4	5.4	5.4	209	211	219	38.3	38.7	40.2
	8				114	115	120	NA	NA	NA
POT.										
	1				278	281	292	NA	NA	NA
	2				246	249	259	NA	NA	NA
	3				272	275	286	NA	NA	NA
	4				420	425	442	NA	NA	NA
	5				464	469	488	NA	NA	NA
	6				459	464	482	NA	NA	NA
	7				209	211	219	NA	NA	NA
	8				114	115	120	NA	NA	NA

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R A B I C R O P S

Rabi Vegetables

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	144.2	144.2	144.2	5127	4728	3807	35.5	32.8	26.4
	2	96.7	96.7	96.7	6930	6391	5146	71.7	66.1	53.2
	3	129.1	152.6	141.3	5960	5496	4425	46.2	36.0	31.3
	4	597.6	597.6	597.6	8214	7574	6099	13.7	12.7	10.2
	5	197.8	233.8	216.5	8683	8007	6447	43.9	34.2	29.8
	6	45.6	45.6	45.6	14236	13128	10571	312.5	288.1	232.0
	7	86.8	86.8	86.8	2276	2094	1684	26.2	24.1	19.4
	8	86.8	86.8	86.8	6839	6292	5061	78.8	72.5	58.3
PHO										
	1	39.3	39.3	39.3	5127	4728	3807	130.4	120.3	96.8
	2	30.5	30.5	30.5	6930	6391	5146	227.4	209.7	168.8
	3	50.0	58.7	53.7	5960	5496	4425	119.2	93.7	82.4
	4	107.4	107.4	107.4	8214	7574	6099	76.5	70.5	56.8
	5	46.1	54.1	49.5	8683	8007	6447	188.4	148.1	130.2
	6	11.8	11.8	11.8	14236	13128	10571	1210.6	1116.4	898.9
	7	21.8	21.8	21.8	2276	2094	1684	104.5	96.2	77.3
	8	21.8	21.8	21.8	6839	6292	5061	314.1	288.9	232.4
POT.										
	1	10.4	10.4	10.4	5127	4728	3807	494.4	455.9	367.1
	2	6.4	6.4	6.4	6930	6391	5146	1082.9	998.6	804.1
	3			10.5	5960	5496	4425	NA	NA	420.9
	4	17.6	17.6	17.6	8214	7574	6099	466.2	429.9	346.1
	5			21.5	8683	8007	6447	NA	NA	300.3
	6	3.3	3.3	3.3	14236	13128	10571	4340.3	4002.4	3222.7
	7	32.5	32.5	32.5	2276	2094	1684	70.1	64.5	51.9
	8	32.5	32.5	32.5	6839	6292	5061	210.7	193.8	155.9

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R A B I C R O P S

Traditional Oilseeds

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	53.0	53.0	53.0	894	688	1093	16.9	13.0	20.6
	2	35.6	35.6	35.6	885	681	681	24.9	19.1	19.1
	3	42.5	42.5	42.5	989	761	1208	23.3	17.9	28.5
	4	219.8	219.8	219.8	526	404	643	2.4	1.8	2.9
	5	65.1	65.1	65.1	592	455	723	9.1	7.0	11.1
	6	16.8	16.8	16.8	651	501	795	38.8	29.9	47.5
	7	31.9	31.9	31.9	1235	1136	914	38.7	35.6	28.6
	8	31.9	31.9	31.9	493	453	364	15.4	14.2	11.4
PHO										
	1	19.7	19.7	19.7	894	688	1093	45.5	35.0	55.6
	2	15.2	15.2	15.2	885	681	681	58.1	44.7	44.7
	3	16.8	16.8	16.8	989	761	1208	58.9	45.3	72.0
	4	53.7	53.7	53.7	526	404	643	9.8	7.5	12.0
	5	15.5	15.5	15.5	592	455	723	38.3	29.4	46.8
	6	5.9	5.9	5.9	651	501	795	110.7	85.1	135.3
	7	10.9	10.9	10.9	1235	1136	914	113.4	104.3	83.9
	8	10.9	10.9	10.9	493	453	364	45.3	41.6	33.4
POT.										
	1				894	688	1093	NA	NA	NA
	2				885	681	681	NA	NA	NA
	3				989	761	1208	NA	NA	NA
	4				526	404	643	NA	NA	NA
	5				592	455	723	NA	NA	NA
	6				651	501	795	NA	NA	NA
	7				1235	1136	914	NA	NA	NA
	8				493	453	364	NA	NA	NA

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R A B I C R O P S

Non-Traditional Oilseeds

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	58.0	58.0	58.0	1076	828	1315	18.5	14.3	22.7
	2	38.9	38.9	38.9	1079	830	1319	27.7	21.3	33.9
	3	46.4	46.4	46.4	1053	810	1288	22.7	17.5	27.7
	4	68.7	68.7	68.7	616	639	621	9.0	9.3	9.0
	5	40.7	40.7	40.7	616	638	620	15.1	15.7	15.3
	6				0	0	0	NA	NA	NA
	7	34.9	34.9	34.9	540	513	486	15.5	14.7	13.9
	8	17.5	17.5	17.5	521	495	469	29.9	28.4	26.9
PHO										
	1	21.4	21.4	21.4	1076	828	1315	50.4	38.8	61.6
	2	16.6	16.6	16.6	1079	830	1319	65.1	50.1	79.6
	3	18.2	18.2	18.2	1053	810	1288	57.7	44.4	70.6
	4	23.3	23.3	23.3	616	639	621	26.4	27.4	26.6
	5	10.8	10.8	10.8	616	638	620	57.2	59.3	57.7
	6				0	0	0	NA	NA	NA
	7	11.8	11.8	11.8	540	513	486	45.6	43.3	41.1
	8	5.9	5.9	5.9	521	495	469	88.0	83.7	79.3
POT.										
	1				1076	828	1315	NA	NA	NA
	2				1079	830	1319	NA	NA	NA
	3				1053	810	1288	NA	NA	NA
	4				616	639	621	NA	NA	NA
	5				616	638	620	NA	NA	NA
	6				0	0	0	NA	NA	NA
	7				540	513	486	NA	NA	NA
	8				521	495	469	NA	NA	NA

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R A B I C R O P S

Rabi Fodder

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	38.1	38.1	38.1						
	2	25.6	25.6	25.6						
	3	30.5	30.5	30.5						
	4	158.0	158.0	158.0						
	5	46.8	46.8	46.8						
	6									
	7	10.9	10.9	10.9						
	8	10.9	10.9	10.9						
PHO										
	1	8.5	8.5	8.5						
	2	6.6	6.6	6.6						
	3	7.3	7.3	7.3						
	4									
	5	6.7	6.7	6.7						
	6	2.6	2.6	2.6						
	7	2.6	2.6	2.6						
	8	2.6	2.6	2.6						
POT.										
	1	0.4	0.4	0.4						
	2	0.3	0.3	0.3						
	3	0.3	0.3	0.3						
	4	0.7	0.7	0.7						
	5	0.6	0.6	0.6						
	6	0.1	0.1	0.1						
	7									
	8									

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R A B I C R O P S

Fruit

		Fertilizer Coefficient (Nutrient Kg/Hectare)			Yield (Kg/Hectare)			Yield/Fertilizer Ratio		
		S	M	L	S	M	L	S	M	L
UREA										
	1	102.4	102.4	102.4	7404	7331	7909	72.3	71.6	77.2
	2	79.7	79.7	79.7	8735	8649	9331	109.6	108.5	117.0
	3	93.2	93.2	93.2	7906	7829	8446	84.8	84.0	90.6
	4	21.8	21.8	21.8	8138	7731	7324	373.3	354.6	336.0
	5	21.8	21.8	21.8	7975	7576	7177	365.8	347.5	329.2
	6	38.8	38.8	38.8	12960	12833	13845	334.3	331.0	357.1
	7	74.8	74.8	74.8	10249	10761	10659	136.9	143.8	142.4
	8	74.8	74.8	74.8	10901	11446	11337	145.6	152.9	151.5
PHO										
	1	114.5	114.5	114.5	7404	7331	7909	64.7	64.0	69.1
	2	91.1	91.1	91.1	8735	8649	9331	95.9	95.0	102.5
	3	111.0	111.0	111.0	7906	7829	8446	71.2	70.5	76.1
	4	6.7	6.4	6.4	8138	7731	7324	1207.4	1213.6	1149.8
	5	6.4	6.4	6.4	7975	7576	7177	1251.9	1189.3	1126.7
	6	7.4	7.4	7.4	12960	12833	13845	1760.8	1743.6	1881.1
	7	13.6	13.6	13.6	10249	10761	10659	752.7	790.3	782.8
	8	13.6	13.6	13.6	10901	11446	11337	800.6	840.6	832.6
POT.										
	1				7404	7331	7909	NA	NA	NA
	2				8735	8649	9331	NA	NA	NA
	3				7906	7829	8446	NA	NA	NA
	4				8138	7731	7324	NA	NA	NA
	5				7975	7576	7177	NA	NA	NA
	6	1.7	1.7	1.7	12960	12833	13845	7714.1	7638.7	8240.9
	7	16.2	16.2	16.2	10249	10761	10659	632.5	664.1	657.8
	8	16.2	16.2	16.2	10901	11446	11337	672.7	706.4	699.6

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REFERENCES

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