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GROWTH AND STAGNATION IN PAKISTAN AGRICULTURE

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OVERVIEW

This report provides a preliminary analysis of the major factors behind agricultural production in Pakistan and, especially, attempts to account for the apparent stagnation of wheat and rice production in the 1980s. It is hoped that this analysis will lead to much more detailed and disaggregated studies by members of the Economic Analysis Network and others in Pakistan.

The central problem is shown in Figure 1. Wheat and rice production in Pakistan have been on something of a roller-coaster ride the past 15 years. While production of both crops grew rapidly during the latter 1970s, the rate of growth of wheat production slowed abruptly in the 1980s, and rice production hit a plateau. Why this occurred is the major focus of attention.

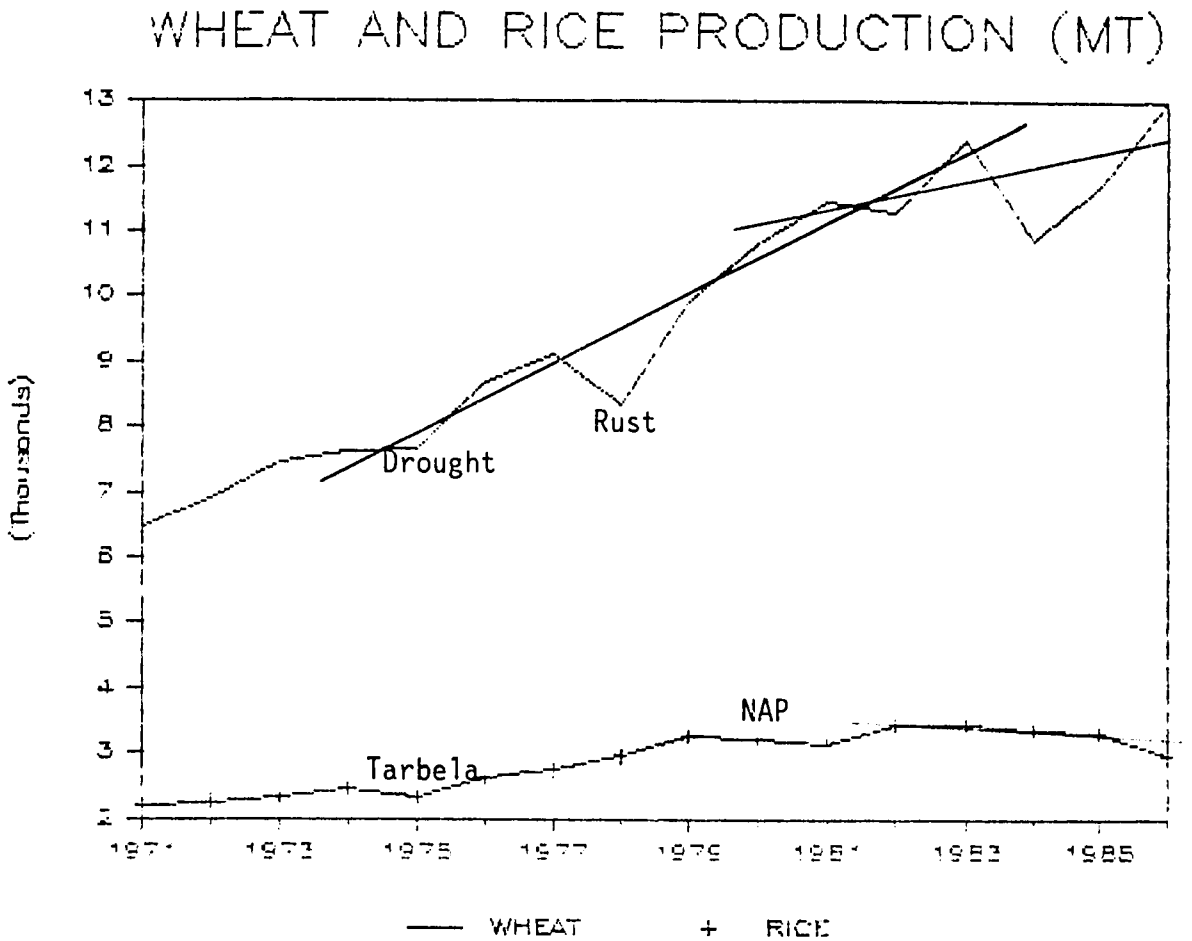
The answer, it is believed, is shown in the singularities noted in Figure 1. In particular, the implementation of the "New Agricultural Policy" (NAP) of 1980 seems to correspond to the beginning of trouble. Two major policy decisions appear to have adversely affected production:

1) Investment in the expansion of irrigated area was reduced in favor of rehabilitation of existing irrigation systems and improved drainage. Whatever the desirability or even necessity of rehabilitation and drainage may be, it is expansion of irrigated area that is the basis for growing agricultural production in semiarid countries like Pakistan.

2) Subsidies to fertilizers and pesticides were reduced while simultaneously farm support prices for wheat and rice were permitted to decrease in real terms. The latter is, of course, another form of reduced subsidies to farmers and increased subsidies to consumers and export markets. As a consequence, Pakistani farmers have been put in a severe price squeeze so that it does not pay them to invest their resources in increased production.

It is difficult to separate the individual effects of these two decisions as they happened more or less at the same time. But this and other studies (Seckler and Sampath, "Production and Poverty in Indian Agriculture") indicate that in all but the most favored agro-climatic areas, expansion of irrigated area rolls out the carpet, so to speak, on which fertilizers, HYVs, labor, and other inputs perform. While biochemical technology can result in short-run gains in production, it rather quickly becomes weakened by diminishing returns to fertilizer and by saturation of crop areas under HYVs (which obviously cannot exceed 100%). Thus in the long run, agricultural production is

Figure 1


WHEAT AND RICE PRODUCTION (MT)
(Thousands)
13
12
11
10
9
8
7
6
5
4
3
2
1971
1973
1975
1977
1979
1981
1983
1985
Drought
Rust
NAP
Tarbela
WHEAT
RICE

determined by basic (and, unfortunately, rare) breakthroughs in HYVs and, especially, by expansion of irrigated area.

This year the GOP has substantially changed the price policy of the past few years by keeping fertilizer prices constant while increasing wheat support prices by 14%. This policy change, together with good weather, has caused fertilizer use in the 1985-1986 wheat crop to increase by about the same percentage amount. Consequently, wheat production is expected to rise from the 11.5 MT level of last year to over 13 MT--again, by about 14% (but not much more that the 12.5 MT level of 1981). While this is a gratifying result (which also corroborates the price squeeze hypothesis), it does not form a sufficient basis for long-term agricultural policy.

Pakistan is experiencing severely diminishing returns to fertilizer use (as shown below in Table 2). This problem can only be solved by breakthroughs in HYVs, expansion of irrigated area, improved quality of irrigation, and better farm management practices (which increase costs of production). While there is still room for crop price increases, the tolerance of consumers and export markets is limited.

Thus it appears that the major avenue for increased food production in Pakistan, which has the potential for feeding a population growing at 3.1% pa, is better management of existing irrigation systems and expansion of irrigation to new areas. Here the word "management" of existing irrigation systems should be emphasized because simple "rehabilitation" of physical structures is not enough. Both the physical and the managerial systems must be improved if these investments are to yield a favorable return. In expansion of irrigated area, tubewell development seems to offer the quickest and least expensive path. However, both these opportunities need very careful assessment because both have problems, especially of a managerial nature.

If, as contended here, it is necessary to expand irrigated area so that Pakistan can feed its rapidly growing population, the question arises as to what will happen when the physical limits of irrigation expansion are reached in the next two or three decades, by which time population will have doubled. Will biochemical technology and "induced innovations" be enough? If there is some presently unforseeable breakthrough, they could be, but, barring miracles, it is most unlikely. Without expansion of irrigated area, what may be called the "required rate of innovation" to increase yields would be roughly the same as the rate of population growth, over 3% pa. This is far too much reasonably to expect. Pakistan must use the time left to reduce its long-run rate of population growth to about one-third the present rate. This is the most important food policy decision facing Pakistan today.

HYPOTHESES

Many hypotheses have been proposed to account for the stagnation in wheat and rice production during the 1980s:

The Weather

The weather can be a culprit, but it usually does not influence trends, as much as variations around trends. Dr. Zakir Hussain has analyzed rainfall data as part of this report (Appendix A). Variations in rainfall seem to have more effect on regional than on total production.

Rising Water Tables and Salinity

This is a problem about which Pakistan has received considerable international attention, but there is very little scientifically reliable data about it. In any case, it is most unlikely that these problems could cause the abrupt changes in the production trends of direct interest here. Also, since rice is more tolerant to water-logging and salinity than wheat, these factors should affect wheat more than rice production. Instead, the decreasing trend for rice production is much more severe than for wheat.

Weak Institutions in Research, Extension, and Marketing

While perhaps the research, extension, and marketing institutions are weak, the fact is that these same institutions produced very good results in the 1970s, and it is most unlikely that they have abruptly deteriorated in the 1980s. While it could be argued that these institutions were adequate for an "easy ride" up the production function but are no longer sufficient in a era of rapidly diminishing returns, this argument seems rather post hoc.

Agricultural Labor Shortages Resulting in Poor Farm Management Practices

Agricultural specialists generally agree that poor farm management practices are employed in Pakistan. The question, however, is whether these practices have deteriorated in recent years because of labor shortages. There has been substantial rural-urban migration in recent years, and about one million workers have gone abroad, out of a labor force of 24 million. Pakistan, like most developing countries, needs much better data on rural employment, wages, and income. Given this limitation, the present guess is that labor shortages have had some, but not a great deal of, effect on the problem at hand.

Reduced Growth of Irrigated Area and Poor Management of Existing Irrigation Systems

The potential effects of irrigation on crop production can be seen in Figure 1 in the dramatic increase of rice production following the Tarbela project. By the same token, as new irrigation development reached a plateau in the 1980s, so too did rice, and to a lesser extent, wheat production. With respect to the management of existing systems, it is interesting to observe that the amount of water supplied per ha of irrigated land in rabi season has increased about 20% since the early 1970s, while the amount of wheat produced per unit of water has remained about constant.

It may also be noted that these labor-irrigation factors together may help explain why wheat yields in the Indian Punjab are about 3 tonnes per ha but only 2 tonnes per ha in the Pakistan Punjab. Appendix B provides some interesting cross-country comparisons. First, there are 1.5 ha of agricultural land per agricultural worker in Pakistan compared to one ha in India. Seventy percent of this land is irrigated in Pakistan compared to 23% in India. Last, it is generally agreed, although more data is needed, that the famous warabandi system of irrigation management is better managed in India than in Pakistan.

A Farm Price Squeeze

As already noted, the farm price squeeze and the lack of growth in irrigated area are the two major suspects in the search for "Who done it?"

WHEAT PRODUCTION

This analysis focuses on wheat production. A similar analysis of rice production should be done. However, an analysis of rice requires separation of the input-output relationships for basmati and HYVs, and this task is far beyond the time available here.

Many regression analyses were run in an attempt to account for the variations in wheat production from 1971 to 1986. The best analysis turned out, in the end, to be surprisingly simple.

First, as shown in equation R1 of Table 1, 94% of the variation in wheat production can be accounted for by the rate of total consumption of fertilizer in the rabi season (about 80% of which is used in wheat). This equation is slightly improved in R2, which has the multiplicative interaction between fertilizer and the percent of the wheat area under HYVs as the independent variable. It should be noted that while many other variables and combinations were tried, these were by far the best equations.

TABLE 1. REGRESSION ANALYSES

EQUATION	DEPENDENT VARIABLE	CONSTANT	PREDICTOR VARIABLES	R2	F VALUE	DW
R1	LOG WHEAT PRODUCTION	0.6894188	LOG FERTILIZER USE IN RABI 0.373371	0.94	194.7	2.22
R2	LOG WHEAT PRODUCTION	6.194768	LOG (% AREA IN HYVS TIMES FERT IN RABI) 0.286026	0.95	232.4	2.03
R3	FERTILIZER USE IN RABI	-2855	TOTAL IRRIGATED AREA 232.91	0.96	275	1.75
R4	CHANGE IN FERT PER HA WHEAT T/(T-1)	0.0055	CHANGE IN RETURN (T-1)/(T-2) 0.006	0.51	10.4	2.00

ALL COEFFICIENTS SIGNIFICANT AT OVER 99%

The next question is this: If fertilizer use (and HYVs) drives wheat production, then what drives fertilizer use? The answer, shown in R3, is again very simple: It is irrigation. Ninety-five percent of the variance in fertilizer use in the rabi season is accounted for by the variance in total irrigated area.

A view of the irrigation-fertilizer relationship is shown in Figure 2. It is seen that as irrigated area expanded from 1975 to 1981, primarily due to Tarbela, fertilizer use grew rapidly. However, as growth in irrigated area slowed after that time, fertilizer use also slowed.

But there is also the fact that fertilizer use decreased considerably during the period 1980-1982, even though irrigated area was expanding. This suggests that irrigation is not the only determinant of fertilizer use; other factors must be considered as well. The question of price ratios between wheat and fertilizer naturally springs to mind. This is the subject of the next section.

WHEAT-FERTILIZER PRICE RATIOS

Table 2 shows the basic price data. Columns A and B show the support and wholesale market prices of wheat, respectively; Column C shows the price of urea. Column D shows the result of dividing total production of wheat pa by 80% (the amount thought to be used in wheat) of the total urea use in the rabi season. The result is the average product of urea in terms of wheat. It is seen that the average productivity of urea fell from 3.56 kg of wheat per kg of urea in 1971 to only 1.67 kg in 1985. Thus there are strongly diminishing returns to urea use in wheat production.

By dividing the price of urea by the price of wheat, the amount of wheat required to purchase one kg of urea is obtained. Column E shows that the wheat cost of urea, in terms of support prices, has been increasing over time. In 1971, 1.24 kg of wheat would purchase one kg of urea; in 1984, 1.60 kg of wheat was required. The price situation improved greatly in 1986 because of the increase in wheat prices.

Farmers' decisions to purchase fertilizer are largely determined by the relationship between both the productivity of fertilizer in terms of the crop and relative prices between fertilizer and the crop. Column F shows this relationship. Here the productivity of urea in terms of wheat, Column D, is divided by the wheat cost of urea, Column E. This ratio gives the return, in terms of wheat, to the farmer's investment in urea. In 1971, an investment in one kg of urea would return 2.87 kg of wheat; in 1986, even after the price rise, the return would be only 1.30 kg of wheat. Columns G and H show the same calculations based on the limited wholesale price data available.

Figure 2

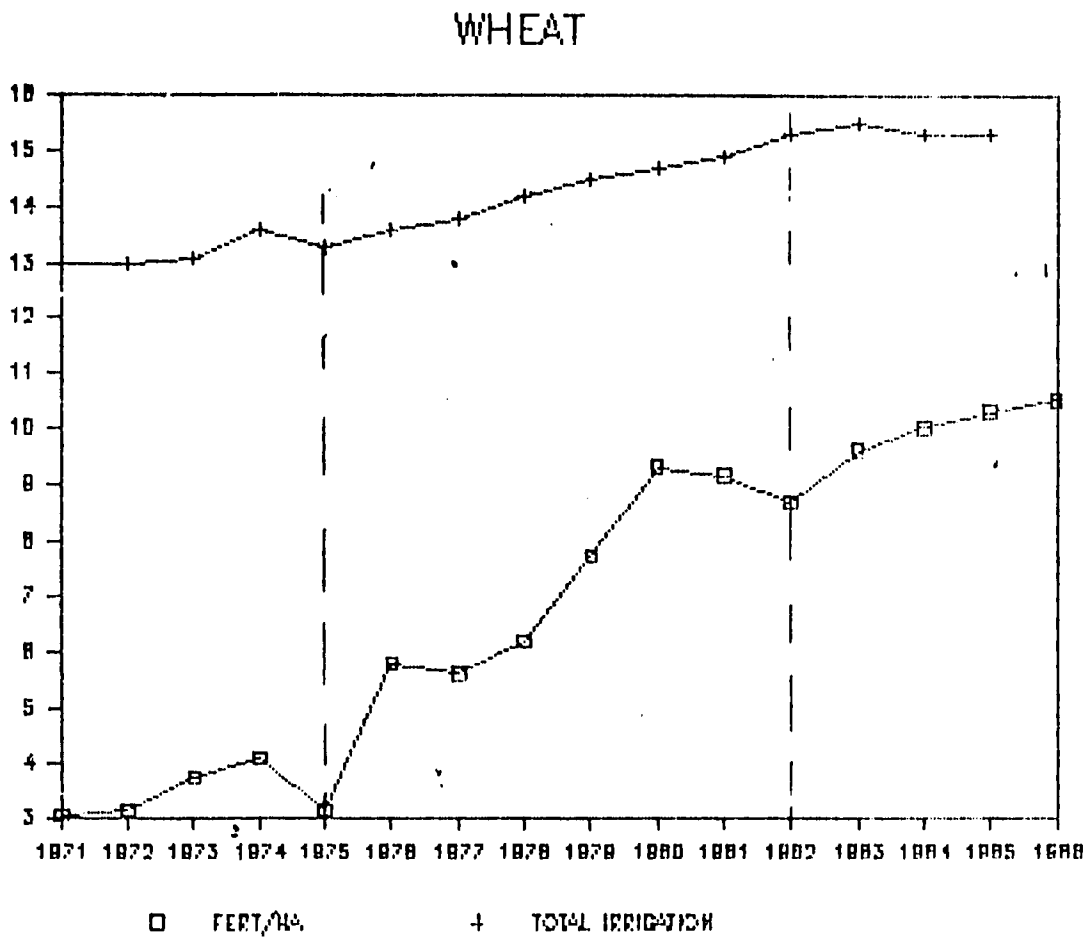

WHEAT
16
15
14
13
12
11
10
9
8
7
6
5
4
3
1971 1972 1973 1974 1975 1976 1977 1978 1979 1980 1981 1982 1983 1984 1985 1986
FERT/HA
TOTAL IRRIGATION

TABLE 2. WHEAT AND UREA PRICES

YEAR	YEAR	A SUPPORT PRICE WHEAT RS/KG*	B WHOLESALE PRICE WHEAT RS/KG**	C UREA PRICE RS/KG	D WHEAT PROD PER KG UREA KG/KG***	E SUPPORT WHEAT COST UREA (C/A)	F SUPPORT RS.RETURN WHEAT/UREA (D/E)	G WHOLESALE WHEAT COST UREA (C/B)	H WHOLESALE RS.RETURN WHEAT/UREA (D/G)	I UREA USE IN WHEAT KG/HA	J WHEAT YEILD KG/HA
1971	1971	0.46		0.57	3.56	1.24	2.87			24.4	1083
1972	1972	0.46		0.57	3.79	1.24	3.06			25.1	1159
1973	1973	0.6		0.7	3.34	1.17	2.86			29.9	1246
1974	1974	0.68		1.14	3.04	1.68	1.81			32.8	1248
1975	1975	0.99	1.17	1.1	4.19	1.11	3.77	1.18	3.55	25.2	1320
1976	1976	0.99	1.04	1.48	2.45	1.49	1.64	1.05	2.34	46.5	1422
1977	1977	0.99	1.11	1.36	2.54	1.37	1.85	1.12	2.26	45.1	1431
1978	1978	0.99	1.37	1.36	2.12	1.37	1.54	1.38	1.53	49.7	1316
1979	1979	1.21	1.35	1.28	1.92	1.06	1.82	1.11	1.73	62.0	1488
1980	1980	1.25	1.36	1.86	1.68	1.49	1.13	1.08	1.55	74.5	1568
1981	1981	1.45	1.55	1.92	1.79	1.32	1.35	1.07	1.68	73.3	1643
1982	1982	1.45	1.80	2.36	1.80	1.63	1.11	1.24	1.45	69.6	1565
1983	1983	1.6	1.93	2.56	1.74	1.60	1.09	1.20	1.45	77.0	1678
1984	1984	1.6	2.00	2.56	1.48	1.60	0.92	1.25	1.18	80.3	1483
1985	1985	1.75		2.56	1.56	1.46	1.07			82.7	1612
1986	1986	2		2.56	1.67	1.28	1.30			84.3	1757

*SUPPORT PRICES FOR THE CROP YEAR (I.E. 1986 = 1985-1986)

** PRICES IN LAHORE CALANDER YEAR

The consequence of decreasing returns to investment in urea is illustrated in Figure 3. Here, urea application per ha (divided by 10) is related to the (support price) return variable ("F", of Table 2) and to the wheat price of urea in the preceding year. This figure indicates that as long as the wheat return is about 1.6 kg or more, farmers will invest in fertilizer, but below that amount they are reluctant to do so. With the low returns of the past five years, the question is not why the rate of growth of fertilizer use--and, consequently, of wheat production--slowed, but rather why it grew at all.

Figure 4 indicates that a possible answer to this question may lie in wholesale, rather than support, wheat prices. The wheat cost of urea in terms of wholesale prices has been more stable than the support price index. Many regression analyses were made to incorporate these price effects into the fertilizer functions of Table 1, but the results were not wholly satisfactory. Much more detailed analysis is needed on these relationships than was possible here. A promising line of further research on this subject is shown in R4 of Table 1. Here the <u>change</u> in urea use per ha is related to the <u>change</u> in the (support price) return to urea in the preceding year. An R^2 value of 0.51 is quite good for change variables.

Nevertheless, it seems clear that Pakistani farmers are going to need more favorable price policies if they are going to invest in increased production. Either crop prices must increase or urea (and other input prices) must decrease, or both. Which should it be?

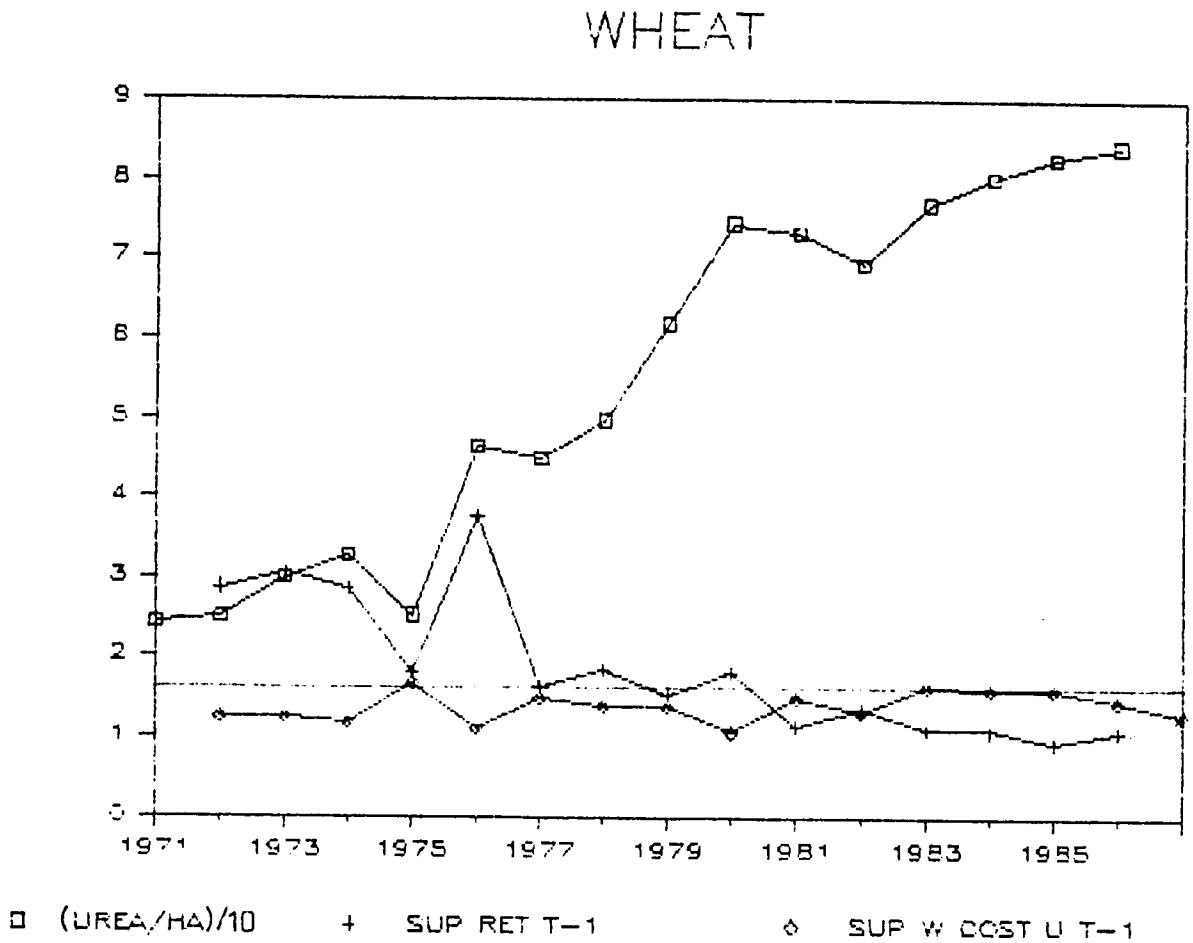
Table 3 provides some insight into this policy question. Current prices have been converted into real prices through the consumer price index (CPI). In real terms, wheat and basmati prices have decreased over 20% since 1979, while IIRI-6 has only gone down in the past two years. Real urea prices went up substantially in the early 1980s but are now down to roughly the 1979 level.

The lower part of Table 3 carries the analysis further by dividing per capita GDP by the real prices. Thus, for example, per capita GDP would purchase 531 kg of wheat in 1979 but 751 kg in 1985, a 42% increase, as shown in the lower right-hand columns. Only urea is at 1979 parity by this index. While the ability to purchase much more food represents a substantial gain in consumers' surplus over this period, it seems that the process has gone too far and some of the surplus should be reallocated back to producers, as in the increased price support for wheat this year.

CONCLUSIONS

It seems clear that fertilizer use and HYVs drive wheat production and that fertilizer use is in turn mainly driven by the combination of expanded irrigated area and "getting prices

Figure 3


WHEAT
9
8
7
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5
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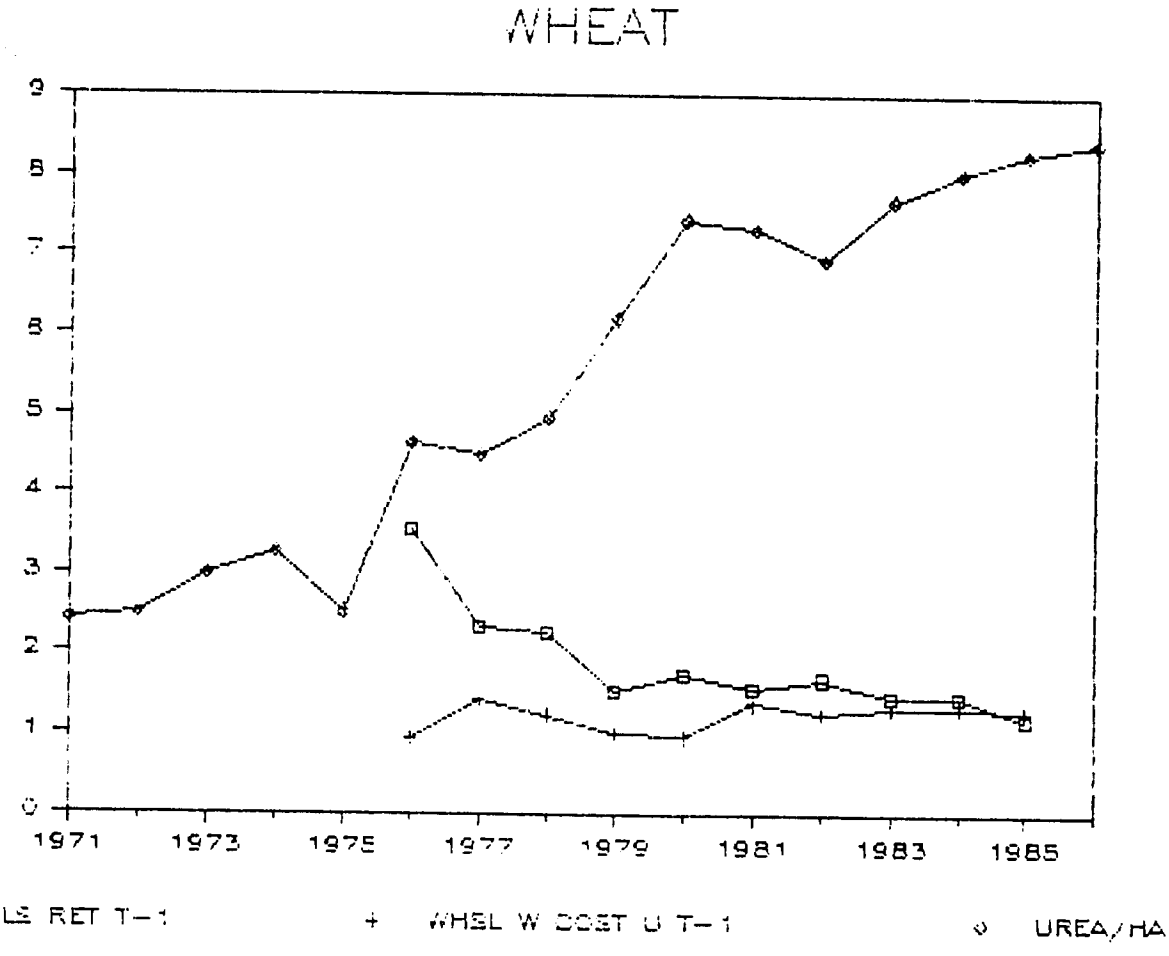
2
1
0
1971
1973
1975
1977
1979
1981
1983
1985
(UREA/HA)/10
SUP RET T-1
SUP W COST U T-1

6a

Figure 4


WHEAT
9
8
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1971
1973
1975
1977
1979
1981
1983
1985
WHLS RET T-1
WHSL W COST U T-1
UREA/HA

TABLE 3. PRICES AND INCOME

YEAR	SUPPORT/MARKET PRICES PER KG				REAL PRICES 1979 BASE					
	WHEAT	BASMATI	IRRI-6	UREA	CPI	BASE	WHEAT	BASMATI	IRRI-6	UREA
1979	1.21	1.61	0.81	1.28	296	1	1.21	1.61	0.81	1.28
1980	1.25	1.61	0.81	1.86	332	1.12	1.11	1.44	0.72	1.66
1981	1.45	1.88	0.97	1.92	375	1.27	1.14	1.48	0.77	1.52
1982	1.45	2.13	1.13	2.36	404	1.36	1.06	1.56	0.83	1.73
1983	1.6	2.2	1.23	2.56	418	1.41	1.13	1.56	0.87	1.81
1984	1.6	2.25	1.28	2.56	462	1.56	1.03	1.44	0.82	1.64
1985	1.75	2.25	1.28	2.56	508	1.72	1.02	1.31	0.75	1.49
1986	2	2.33	1.33	2.56	559	1.89	1.06	1.23	0.70	1.36

YEAR	REAL PRICES IN RELATION TO PER CAPITA GDP (RUPEES: 1959-1960 BASE) REAL GDP/ PRICE					PERENT CHANGE OVER 1979				
	PC GDP	WHEAT	BASMATI	IRRI-6	UREA	PC GDP	WHEAT	BASMATI	IRRI-6	UREA
1979	642	531	399	793	502	1.00	1.00	1.00	1.00	1.00
1980	666	598	464	922	402	1.04	1.13	1.16	1.16	0.80
1981	682	596	460	891	450	1.06	1.12	1.15	1.12	0.90
1982	737	694	472	890	426	1.15	1.31	1.18	1.12	0.85
1983	736	650	472	845	406	1.15	1.22	1.18	1.07	0.81
1984	736	718	511	897	449	1.15	1.35	1.28	1.13	0.89
1985	766	751	584	1027	514	1.19	1.42	1.47	1.30	1.02

SOURCE: WORLD BANK, 1985

right". Subject to more detailed research than has been possible here, several major policy issues emerge from this analysis.

1) The development of new irrigated area seemed to have stopped in favor of rehabilitation of existing systems. But simple physical rehabilitation only preserves the status quo ante--in fact, if not in theory--and thus the prime driver of Pakistan's wheat production, expansion of irrigated area, has been stopped in its tracks.

2) It is often thought that "vertical production"--i.e., higher yields--is the most economical path to agricultural development. This is a theory that has yet to be proven, one about which the writer has serious reservations. But even so, vertical production does not come out of the air, it comes out of inputs--of fertilizer, HYVs, and labor. And the farmer must have the proper prices to encourage him to invest in these inputs. It appears, at least up to this year, that agricultural policy in Pakistan has not been providing the proper price incentives and that crop prices should be increased. Even substantial increases will leave consumers much better off than they were in 1979 relative to their income.

Thus it appears to the writer that current fertilizer prices should be frozen for a year or two and that crop prices, especially of wheat and basmati, should be increased. This may provide a short-run stimulus to crop production in Pakistan. But in the long run, the prospects for sustained growth without expansion of irrigated area and improved management of existing irrigation systems are dim. Pakistan clearly needs to develop a "new irrigation strategy" based on an objective assessment of the experience of the past and careful quantitative assessments of the technical and managerial opportunities of the future.

Finally, unless Pakistan can control the growth of its population, there is no foreseeable solution to the food problem.

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Appendix A. WHEAT AND RICE RESPONSE TO RAINFALL IN THE INDUS BASIN (A TIME SERIES ANALYSIS)

by Dr. Zakir Hussain (USAID)

Wheat and rice are the two major food grain crops. Of the total wheat 80 percent is cultivated in the irrigated areas and rice is almost irrigated crop. Both these crops experienced Green Revolution technologies in the past two decades. In the past two years production of these crops is declining to an alarming extent. Several experts are attributing this phenomena to unfavourable weather condition. In this note efforts have been made to help scan the impact of rainfall in the critical months of growing season of rice and wheat.The ensuing discussion seperatly deals with the wheat and rice.

WHEAT PRODUCTION RESPONSE TO RAINFALL.

Wheat production and rainfall data was obtained from the Ministry of food and agriculture for the past fifteen years (1971-1985).The critical rainfall months December through January for wheat crop were identified.The same months were then deflated with the normal rainfall of the these months (normal rainfall is the average of preceding twenty years) and eventually rainfall indicies were calculated. In similar fashion these indicies were identified as independent variables for the provinces and overall equations. The equations are as follows:

$$Y = a + bXi + T + e \qquad (1)$$

$$LnY = a + b\ LnXi + T + e \qquad (2) \qquad (i,---,11)$$

Where:

Y = production (000 tons), X = weather index ,Ln= Log,e = error term,T= time trend,a and b are parameters to be estimated.

On Pakistan basis seven independent variables (Punjab,Sind and Pakistan linear and log linear rain indicies and trend) were regressed against linear and log linear production of wheat. Stepwis regression was used to delineate the effect of each regressor.The results are obtained in table 1. The analysis revealed that wheat production has grown at 4 percent per annum and the coefficient of trend variable was highly significant at 99 percent probability level. Of all the indicies Sind rainfall index turned out to be significant perhaps it precipitates in the month of December in Sind which is critical period for wheat crop tillering. This will become more clear from the foregoing analysis.There seems to be no problem of auto-correlation (D.W.2.3) and explained variance is as high as 9 percent (R2 .93).

The above two equations were fitted to Punjab data in log and linear terms and stepwise regression was applied to help scan the impact of rainfall in the critical months. The results are again reported in table 1 which shows that production grew at 3 percent and January rain turned out to be critical month for this staple foo crop.Surprisingly enough the canal authorities close the canals in the month of January which adversely effects the yield of wheat. There is no problem of auto-correlation (D.W.2.56) and R2 is fairly high (.93). In case of Sind province trend variable turned to be highly significant and wheat production grows at annual rate of 5 percent. Fuerthermore, December rain has important bearing on the productivity of this crop.It may not be out of place to mention that wheat is sown 2-3 weeks ealier in Sind as compared to Punjab. The general fit of the equation is pretty good .

RICE PRODUCTION RESPONSE TO RAINFALL.

Rice production in Pakistan is mainly irrigated. However,precipitation does effect its productivity. Due to monson rainfall irrigation water in the canals is plentiful and rice tracts also get augmented water supplies.The critical months identified wer July,August and September.As explained above similar rain indicies for these months and repective provinces were developed. The above mentioned two equation were subjected to stepwise regression analysis. The overall Pakistan results show that rice production grows at annual rate of 2.4 percent and non of the rainfall indicies appeared in both the equations. Sind results are similar to Pakistan and production growth rate is 1.5 percent. However, the Punjab situation is quite different.The production trend is 2.8 percent and August rain index linear as well as log term appeared in the equations. August rain has tonic effect on the rice yield but too much rain in this month becomes toxic to crop due to pest infestation (wet weather) and waterlogging.

Table 1

REGRESSION RESULTS RELATING WHEAT AND RICE PRODUCTION TO RAINFALL

Dependent Variable	Constant	Trend	Sind Rain	January Rain	August Rain	DEC Rain	R2 D.W
		WHEAT PRODUCTION (000) TONS					
Pakistan	-735397.	376.28 *	2.57 *				0.92
		(33.309)	(1.222)				(2.31)
Pakistan **	-74.223	0.042 *	0.00029 *				0.93
		(0.003)	(0.00013)				(2.31)
Punjab	-490921.	251.53 *		8.377 *			0.93
		(22.472)		(2.651)			(2.55)
Punjab **	-65.462	0.038 *		0.001 *			0.93
		(0.003)		(0.003)			(2.42)
Sind **	-99.903	0.054 *				0.00009 *	0.94
		(0.004)				(.00005)	(1.8)
		RICE PRODUCTION (000) TONS					
Pakistan	-118904.	61.482 *					0.63
		(12.722)					(0.57)
Pakistan **	-38.574	0.023 *					0.64
		(0.004)					(0.57)
Punjab	-142.97	35.402 *			-142.97 **		0.71
		(7.255)			(62.427)		(1.36)
Punjab **	-49.503	0.028 *		-0.662**	0.005 *		0.89
		(0.003)		(0.138)	(0.001)		(1.31)
Sind **	-22.552	0.015 *					0.31
		(0.006)					(0.79)

*/ The coefficient is significantly different from zero at .01 probability level.

**/ Log function.

( )/ Standard error.

Appendix B.

The Agricultural Economy of Pakistan in a Regional Perspective*
(1980-1982)

	Pakistan	India	Nepal	Bang-ladesh	Sri Lanka
1. Land Area ('000 km^2) 1/	804	3,288	141	144	66
2. Population (millions, mid-1982)	87.1	717	15.4	92.9	15.2
3. Average Growth Rate of Population (%) 1/					
(a) 1960-70	3.0	2.3	2.6	2.6	1.7
(b) 1970-82	2.7	1.9	2.6	2.9	1.8
4. Percentage Rural Population 1/ in Total Population (1982)	71	76	94	88	76
5. GDP per capita (dollars, 1982) 1/	380	260	170	140	320
6. Growth of GDP (%) 1/					
(a) 1960-70	6.7	3.4	2.5	3.7	4.6
(b) 1970-82	5.0	3.6	2.7	4.1	4.5
7. Agriculture's Share of Aggregate GDP (1982, %) 1/	31	33	N.A.	47	27
8. Per Capita GDP from Agriculture (1982 current dollars) 1/	88	69	N.A.	56	78
9. Growth in GDP from Agriculture 1/					
(a) 1960-70	4.9	1.9	N.A.	2.7	3.0
(b) 1970-82	2.7	1.8	N.A.	2.3	3.2
10. Agriculture's Share of Total Labor Force (1960, %) 1/	57	71	93	74	54
11. Merchandise Exports (1981, %) 1/					
(a) Primary Commodities	40	33	69	32	65
(b) Textiles and Clothing	41	23	24	56	16
12. Merchandise Imports (1981, %) 1/					
(a) Food	14	9	4	20	19
13. Food Aid in Cereals ('000 mt) 1/					
(a) 1974/75	619	1582	0	2,130	271
(b) 1981/82	368	416	10	1,076	195
14. Index of Food Production (1969-71=100)	145	135	112	121	179
15. Average Index of Food Production Per Capita 2/ (1969-71=100) 1980-82	105	101	83	94	154
16. Index of Agricultural Production 2/ (1969-71=100) 1981	142	134	111	118	145
17. Food Supply 2/					
(a) Calories per Capita per day (1978-80)					
Vegetable Products	2055	1909	1781	1810	2176
Animal Products	247	89	113	67	73
(b) Protein (grams) per Capita per day (1978-80)					
Vegetable Products	46.1	43.9	39.0	35.3	37.6
Animal Products	14.1	4.6	6.7	5.3	6.5
18. Hectares of Land a/ 2/ Per Agricultural Worker (1980) 2/	1.591	1.015	0.365	0.356	0.766
19. Percentage of Land Irrigated (%) 2/a/	70.4	23.3	9.9	17.7	24.5
20. Percentage of Land Under Cereals a/ b/	53.4	61.3	96.4	118	39.5
21. Average Yield Cereals (kg/ha/1981)	1,670	1,443	1,675	1,964	2,629
22. Percentage of Land Under Wheat (1981) a/	31.0	13.1	16.3	6.5	"
23. Wheat Yield (kg/ha/1981) 2/	1,760	1,649	1,296	1,668	"
24. Percentage of Land Under Paddy (1981) 1/	9.5	21.7	[illegible]	110.4	37.3
25. Rice Yield (kg/ha/1981) 2/	2,560	2,090	1,895	1,980	2,525
26. Hectares of Land per Tractor (1980) 2/a/	442	405	4,481	2,230	89
27. Fertilizer Use per Hectare a/ (kg/ha/1980) 3/	69.5	31.0	9.7	46.1	77.0

Sources: 1/ World Bank, World Development Report, 1984.
2/ FAO, 1981 Food Production Yearbook, Vol. 35, 1982.
3/ FAO, 1981, Fertilizer Yearbook, Vol. 31, 1982.

a/ Arable land plus land in permanent crops per economically active person in the agriculture sector.
b/ Area may be planted more than once.

Source: ADB, 1985

Appendix C. Data Sheet

3/16/86

CROPEX 3-2-86

YEAR	WPROD	WAREA	WYLD	WYLD*10	WYLDIRR	WYLDNIR	WAIR	WAIRR%	RPROD	RYLD	RAREA
1971	6476	5977	1083	10835	1330	392	4407	0.74	2200	1464	1503
1972	6890	5797	1189	11885	1439	452	4347	0.75	2262	1554	1456
1973	7442	5971	1246	12464	1485	526	4462	0.75	2330	1574	1480
1974	7630	6113	1248	12482	1494	544	4520	0.74	2455	1624	1512
1975	7674	5812	1320	13204	1549	572	4456	0.77	2314	1443	1604
1976	8691	6110	1422	14224	1669	646	4594	0.75	2617	1530	1710
1977	9144	6390	1431	14310	1691	639	4811	0.75	2737	1565	1749
1978	8367	6360	1316	13156	1510	675	4881	0.77	2950	1553	1899
1979	9950	6687	1488	14880	1678	824	5200	0.78	3272	1615	2026
1980	10856	6924	1568	15679	1754	877	5454	0.79	3216	1581	2034
1981	11475	6984	1643	16430	1847	908	5466	0.78	3123	1616	1933
1982	11304	7223	1565	15650	1764	823	5698	0.79	3430	1736	1976
1983	12414	7398	1678	16780	1887	945	5760	0.78	3445	1742	1978
1984	10882	7343	1482	14820	1670	780	5795	0.79	3340	1672	1998
1985	11703	7258	1612	16124	1828	780	5800	0.80	3315	1659	1998
1986	13000	7400	1757	17568					2970	1588	1870

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RXWPROD	BASPROD	BASA	BASYLD	BASXT	FERTK	FERTR	FERT/HA *10	*10	LI	FERTT	PRICE W/U
0.34					185	182	3.05	1820	182	367	0.81
0.33					185	182	3.14	1820	223	367	0.81
0.31	400	338	1183	0.17	184	223	3.73	2230	251	407	0.85
0.32	486	375	1296	0.20	212	251	4.11	2510	183	463	0.59
0.30	602	494	1219	0.26	241	183	3.15	1830	355	424	0.90
0.30	642	536	1198	0.25	296	355	5.81	3550	360	651	0.67
0.30	660	530	1245	0.24	278	360	5.63	3600	395	638	0.73
0.35	560	515	1087	0.19	284	395	6.21	3950	518	679	0.73
0.33	878	678	1295	0.27	339	518	7.75	5180	645	857	0.94
0.30	887	779	1139	0.28	426	645	9.32	6450	640	1071	0.67
0.27	960	824	1169	0.31	395	640	9.16	6400	628	1035	0.76
0.30	1055	844	1250	0.31	442	628	8.69	6280	712	1070	0.61
0.28	1010	836	1209	0.29	505	712	9.62	7120	737	1217	0.63
0.31	965	835	1156	0.29	495	737	10.04	7370	750	1232	0.63
0.28					500	750	10.33	7500	780	1250	0.68
0.23						780	10.54	7800	750		0.78

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A	B										
SW/D	WPROD/D	WRATIO	WRAT+1	*1000	WPROD/TOTL1		L2	*1000	RAINW	RAINR	TRAIN
1.23	3.56	2.88		810	0.65	0.69	0.74	744	70	26	48
1.23	3.79	3.07	2.88	810	0.69	0.74	0.76	763	43	38	41
1.18	3.34	2.84	3.07	850	0.74	0.76	0.77	767	84	29	57
1.69	3.04	1.79	2.84	590	0.76	0.77	0.87	869	37	37	37
1.11	4.19	3.77	1.79	900	0.77	0.87	0.91	914	126	72	99
1.49	2.45	1.64	3.77	670	0.87	0.91	0.84	837	198	107	153
1.37	2.54	1.85	1.64	730	0.91	0.84	1.00	995	122	17	70
1.37	2.12	1.55	1.85	730	0.84	1.00	1.09	1086	182	62	122
1.06	1.92	1.81	1.55	940	1.00	1.09	1.15	1148	75	105	90
1.45	1.68	1.13	1.81	690	1.09	1.15	1.13	1130	65	73	69
1.32	1.79	1.36	1.13	760	1.15	1.13	1.24	1241	87	180	134
1.64	1.80	1.10	1.36	610	1.13	1.24	1.09	1088	47	94	71
1.55	1.74	1.10	1.10	650	1.24	1.09	1.17	1170	166	72	119
1.59	1.48	0.93	1.10	630	1.09	1.17	1.30	1300	167	34	101
1.47	1.56	1.06	0.93	680	1.17	1.30			93	26	55
1.28	1.67	1.39	1.06	780	1.30						

TIRR	/10	CANIRR	TWATER	FETIRR	TWELL	WATERR	RPROD/W	WATERR	WPROD/W
13	1.3	9.2	70	26.2	13	45	48.89	25	255.04
13	1.3	9.2	71.1	28.2	14.6	46	49.17	25	275.60
13.1	1.31	9.4	81.2	31.1	15.8	52	44.81	30	248.07
13.6	1.36	9.6	80.1	34.0	17	49	50.10	31	246.13
13.3	1.33	9.7	77	31.9	18	50	46.28	27	284.22
13.6	1.36	9.9	85	47.9	19.4	50	52.34	34	255.62
13.8	1.38	9.7	85	46.2	20.5	48	57.02	36	254.00
14.2	1.42	10.1	89.4	47.8	21.6	53	55.66	37	226.14
14.5	1.45	9.6	87.4	59.1	22	51	64.16	37	268.92
14.7	1.47	10.4	94	72.9	24	56	57.43	38	285.68
14.9	1.49	10.7	96	69.5	25	59	52.93	39	294.23
15.3	1.53	11	99	65.9	26	59	58.14	40	282.60
15.5	1.55	11	102	78.5	26.3	59	58.39	42	295.57
15.3	1.53	11	104	80.5	27	61	54.75	43	253.07
15.3	1.53	11	106	81.7	27	61	54.34	44	265.93

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