Staff Papers Series

Staff Paper p73-23 August 1973

The Economic Structure of Murethi Villiage

By K. William Easter

Department of Agricultural and Applied Economics
University of Minnesota

Department of Agricultural Economics

University of Minnesota
Institute of Agriculture
St. Paul, Minnesota 55101

Staff Paper P73-23 August 1973

The Economic Structure of Murethi Village

K. William Easter

Department of Agricultural and Applied Economics
University of Minnesota

THE ECONOMIC STRUCTURE OF MURETHI VILLAGE*

K. William Easter**

For centuries the irrigated rice farms of eastern India have followed the age-old practice of field-to-field flood irrigation. The water flows through each farmer's field before it reaches the farmers farthest from the canal outlet. The individual farmer has little control over the timing or the quantity of water applied to his fields. He can stop the flow of water through his fields, but only if he can withstand the wrath of the farmers below.

In one effort to improve this traditional irrigation system, the Ford Foundation, Raipur District IADP, and Raipur Agricultural College started a cooperative water use and management project in Raipur District of Madhya Pradesh, India. The basic idea was to install an improved water distribution system in part of a tank-irrigated village. An area of approximately 26 acres in Murethi Village of Arang block was selected for the pilot water use and management project. (See map.) An irrigation channel 2000 feet long, lined with bricks and cement, was constructed from the main canal outlet to the drain, which runs along the eastern boundary of the irrigated area. Ten lateral channels ten

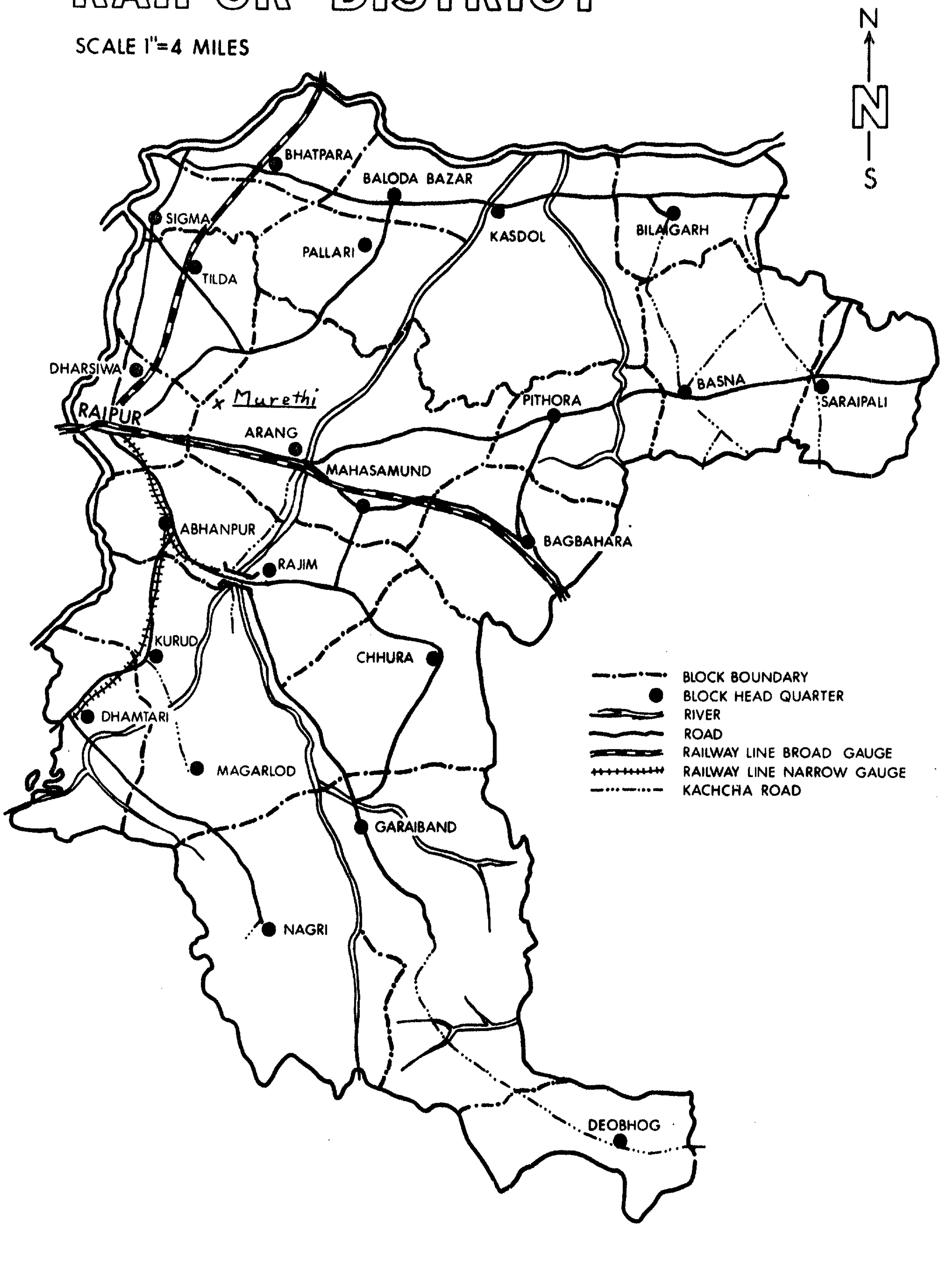
---

* Report prepared for the use of Raipur District, Madhya Pradesh and the Ford Foundation, India Field Office.

** K. William Easter is Associate Professor, Department of Agricultural and Applied Economics, University of Minnesota, and formerly Consultant, Ford Foundation, New Delhi, India. The author would like to thank Shrinath Singh, Robert W. Jolly, and the Raipur IADP staff for their valuable help in the study.

RAIPUR DISTRICT

SCALE 1"=4 MILES



feet long and lined with bricks were constructed from the ten outlets of the 2000-foot channel. Unlined field channels are to be dug from these ten lateral channels to each of the farmers' fields within the 26 acres. Two surface drains, each 2500 feet long, were installed to take the excess to the drain on the eastern boundary.

It is hoped that this pilot project will be expanded within the village to the remaining irrigated area and serve as an example to other villages.[1/] The improved water control should allow the individual farmer to adopt a two-crop system and to apply water when it is needed. Currently all farmers must grow only rice during the wet (kharif) and dry (rabi) seasons due to the field-to-field flooding system. The water saved through the more efficient distribution system should increase the area irrigated in the dry season. The improved drainage will provide better conditions for the wet season harvest by removing excess water. The new system has already reduced the need for large levees and made several additional acres available for cropping. With assured irrigation, farmers no longer require large levees for storing water in case of a short monsoon.

This study is designed to provide a picture of the Murethi Village economy before the installation of the new irrigation system.

[1/] Tank irrigation accounts for ten percent of the irrigation in Raipur District, or 19,800 hectares in 1970-71. The pilot project can also be applied to some of the canal-irrigated areas which account for 84 percent of the irrigated area, or 172,600 hectares [6 p. 21].

After the new system is operating, a follow-up study will measure the economic progress accruing from the improved irrigation. The 1970-71 survey included all the landowners in the village, with the exception of about six absentee owners living in Raipur City who could not be contacted. Since the number of cultivators who operate only rented land is negligible, their exclusion did not affect the final results. All farmers cultivating in the project area were included in the survey.

Climate and Soils

The climate in Raipur is hot with a high humidity during the monsoon. The maximum temperatures of 45^{o}, occurring in May and June, bake the soil and make animal powered tillage difficult. The Southwest monsoon normally brings heavy rains from late June through September with rains sometimes extending into October. Over 90 percent of the average 53 inches of rain falls in this four-month period. Of course, the distribution of rainfall over the four months is critical for the wet season rice crop. Seedbed preparation must await monsoon to permit proper tillage. A general rule-of-thumb is that four inches of rain must fall before all tillage and seedbed preparation activities can be completed for broadcast planting [2 p. 2]. In the case of transplanting, an additional three inches is considered necessary. Since about half the time a total of seven inches of rainfall is not received until July, transplanting tends to be restricted to the irrigated areas. Rain in September and October is also very critical for the rice crop with between six and seven inches required to grow a crop, and 13 inches to produce a good crop [5 p. 24].

During 1944-64, the four-inch minimum beginning rainfall was not obtained until July in three out of the 21 years. On the other hand, only once in 21 years did the rainfall fail to reach the 40 inches considered necessary for an average crop while during nine years enough rain fell to grow a good crop, 50 inches. The September-October rains fell short of six inches two years out of 21, but failed to reach 13 inches 11 times. Consequently, approximately 80 percent of the time irrigation could have increased yields either by allowing earlier planting or extending the growing season. During 1970, Murethi Village, as well as the rest of Raipur, received heavy rains. The distribution and quantity were adequate for a good crop and to fill the irrigation tank.

Three broad soil series are found in Murethi Village. First, the Lakholi series, on upland soil, is suited only for grass land, Second, the Chandkhui series is good for rice production during the wet season and when irrigated can grow most crops. Finally, the Arang series, the only one in the project area, produces rice as well as millets and pulses. The Chandkhui series is found on the edge of the 190-acre irrigated area but the Arang series is the dominate soil.

Irrigation and Crops

Since Murethi Village, like most villages in Raipur District, suffers from both acute water shortages during the hot dry season and excess water during the monsoon, water is an important restraint. The Kurud tank (small reservoir), the only source of irrigation water, provides water for several villages in the area. The first priority is supplemental irrigation during the wet season and if adequate water is available, the Irrigation Department may provide water for a dry season crop. However, there is always uncertainty concerning delivery of water during the dry season with a crop only possible every two or three years. Some years the farmers have planted a dry season crop but no water was delivered and the crop failed.

The major crop is rice although oilseeds, small millets (kodo) and pulses are grown, the latter taken as a utera crop (catch crop). The seeds for the utera crop are broadcast in the standing wet season rice while there is sufficient moisture. The October planting is followed by harvesting in January or February. On some of the upland areas and on unleveed soils small millets or other crops are raised but the acreage varies from year to year with the rainfall and acreage of rice.

With the heavy rainfall in 1970 the wet season crop clusively rice. In addition, heavy showers and hailstorms damaged the utera crop during the flowering stage while no dry season crop was planted so that work could start on the irrigation project.

Social-Economic Conditions

The village consists of a large number of small, schedule class, owner-cultivators with only a small percentage of rented land. Less than one-third of the farm families have holdings larger than 7.5 acres.[2/] Only five farmers have holdings of 20 acres or more and three are over 40 acres but they tend to dominate the village government (Panchayat).

[2/] Holdings included land owned and cultivated plus land rented in and cultivated. Land rented out is excluded while fallow land is included when calculating farm size.

Agriculture is the main vocation of the village with no other supplemental cottage or village industry. The farmers depend primarily on their farm income and on the wet season rice crop. Many smaller farmers work as farm laborers to supplement their income. In 1970-71, 17 of the small farmers and ten of the medium-sized farmers had at least one male family member working as farm laborers on an average of 90 work days per year.

The farmers usually sell their unhusked rice to the larger farmers or the cooperative marketing society. Only a few farmers are in a position to sell their rice at the town markets. Unhusked rice (paddy) is transported to the market in bullock carts, although some of the local businessmen use trucks. Farmers generally sell high-yielding varieties and keep local varieties of rice for their own consumption.

Not a single good (pucca) house exists in the village while child marriages and polygamy are still common. Only one small primary school is available but no village electricity. The barter system still prevails, with the villagers buying goods from the shops and large farmers even making loans in unhusked rice. Thus, in general, this village is backward in spite of the slow but noticeable progress made under the assistance of the Intensive Agricultural District Program (IADP).

Wet Season Rice

The survey included almost all the wet season crop land. The 179 acres of irrigated rice land is only ten acres less than reported for the village in 1969-70 while the 256 acres of non-irrigated rice land is 36 acres greater. The larger area of non-irrigated rice is consistent with the good rainfall in 1970-71 while the ten additional acres reported as irrigated in 1969-70 could have been non-irrigated some years.[3]

The distribution of land holdings is important in understanding the slow progress of the village. Thirty percent of the farmers farm 73 percent of the land while the smallest one-third farm only 9 percent of the land (see Table 1). The project area repeats the same pattern with three large farmers farming almost 75 percent of the area.[4]

Production

Rice production is good for the wet season although some of the crop experienced insect damage. Seven farmers reported medium to heavy insect damage and four light damage. High yielding varieties (HYV's) account for slightly over a quarter of the rice crop in 1970-71 a drop from almost 40 percent in 1969-70 and reverses a three-year

---

3/ The utera crop amounts to 36 acres of pulse (Teura), 10 acres of which were on irrigated land and in the project. During the preceding years, 1967-69, the combined dry season and utera crop ranged from 124 to 150 acres. The predominate dry season crop was rice and yields were low due to limited water for irrigation. However, in evaluating the irrigation project a limited utera and dry season production should be included for the pre-project situation.

4/ There was some uncertainty concerning the exact area of the water use and management project while the survey was being conducted. In fact, some information indicated that the ownership pattern in the actual project area was even more concentrated than shown by the survey.

Table 1. Net Land in Farms by Farm Size, 1970-71[a/]

Farm Size[b/]	Total Village					
	Farm Numbers	Average Farm Size	Rice Land	Fallow Land	Other Cropland[c/]	Total
	- - - - - - - -	- - - - - - - -	- - - -	acres - - - -	- - - - - - - -	- - - - - - - -
Small	28	2.0	51.4	3.3	0.6	55.4
Medium	20	5.4	78.5	22.0	9.4	109.8
Large	22	20.0	305.6	108.1	26.5	440.1
All Farms	70	8.6	435.4	133.4	36.5	605.3

Project Area

Rice Land

	Farm Numbers	HYV's	Local Varieties	Total
	- - - - - - - -	- - - - - - - -	- - - acres - - -	- - - - - - - -
Small	4	2.0	0.9	2.9
Medium	4	2.8	1.0	3.8
Large	3	19.9	0	19.9
All Farms	11	24.7	1.9	26.6

a/ The acreage of utera crops is excluded from these figures.

b/ Small farms are 3.5 acres and under, medium size farms are 3.6 acres to 7.5 acres and large farms are above 7.5 acres.

c/ Other cropland includes 34.5 acres of small millets, 1.5 acres of oilseeds and .5 acres of vegetables in the non-irrigated area. The average yield for the millets was only 200 kgs. per acre.

upward trend.[5/] The area of HYV's in 1970-71 is almost the same as reported in 1968-69.

The HYV's yielded 1.6 quintals per acre more than local varieties (Table 2). The yield difference is even greater between irrigated and non-irrigated land, 2.3 quintals per acre. Within the HYV's no consistent difference exists between yields on irrigated and non-irrigated land due to the very small acreage of HYV's planted on non-irrigated land (see Table 3). Yield differences occur within local varieties as the irrigated areas produce an average of 1.3 quintals per acre more than non-irrigated areas. Within the irrigated areas the HYV's show consistently higher yields, 1.2 quintals per acre more than local varieties. The same is true for non-irrigated land with the average difference between HYV's and local varieties of 2.8 quintals per acre.

Although significant yield differences are not present between farm size groups, the small farmers tend to have the highest yields while the medium size farmers have the lowest. Within the project area the small farmers have much higher yields but they farmed less than three acres of the 26.6 acres. For the large farms one farmer owns most of the 20 acres in the project and he did not use any fertilizer on either his 16 acres in the project or the 20 acres of non-irrigated

---

[5/] Acres under HYV's during the wet season.

1967-68	42
1968-69	106
1969-70	163
1970-71	111

Table 2. Rice Yields by Variety and Farm Size, Wet Season, 1970-71.[a/]

Total Village

Farm Size	High Yielding Varieties Irrig.	High Yielding Varieties Non-Irrig.	High Yielding Varieties Total	Local Varieties Irrig.	Local Varieties Non-Irrig.	Local Varieties Total	Total Irrig.	Total Non-Irrig.	Grand Total
	quintals/acre								
Small	9.5	6.1	8.8	7.5	5.3	5.8	8.6	5.4	6.7
Medium	7.9	10.2	8.6	7.0	4.9	5.0	7.5	5.3	5.8
Large	8.1	8.9	8.1	6.9	5.5	5.9	7.6	5.5	6.5
All Farms	8.2	8.5	8.3	7.0	5.7	5.7	7.7	5.4	6.4

Project Area

	High Yielding Varieties	Local Varieties	Grand Total
	quintals/acre		
Small	10.0	11.0	10.3
Medium	7.6	3.0	6.4
Large	6.6	n.p.*	6.6
All Farms	7.0	5.1	6.8

* None planted.

a/ One quintal equals 100 kgs. or 4.9 bushels.

Table 3. Land in Rice by Variety, Wet Season, 1970-71*

Farm Size	Total Village: High Yielding Varieties			Total Village: Local Varieties			Total Irrig.	Total Non-Irrig.
	Irrig.	Non-Irrig.	Total	Irrig.	Non-Irrig.	Total		
	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - acres - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -	- - - - - - - -
Small	11.5	3.3	14.8	8.9	27.7	36.6	20.4	31.0
Medium	11.5	4.7	16.2	7.1	55.1	62.2	18.6	59.9
Large	78.5	1.5	80.0	61.7	163.9	225.6	140.2	165.4
All Farms	101.5	9.5	111.0	77.7	246.7	324.4	179.2	256.3

* Figures may not add due to rounding.

land. Because the farmer was a defaulter with the cooperative he may have been unable to obtain fertilizer. This one farmer greatly prejudices the project area results downward. If he does not use fertilizer the project benefits will be quite limited and not representative of what could be done in the rest of the irrigated area or in other villages. On the other hand, should he use fertilizer after the project is installed the increase in production will largely be due to the fertilizer and not just the project. Thus for future comparisons the total irrigated area should be used as the base rather than just the project area.[6/]

Fertilizer and Transplanting

As would be expected the average fertilizer use tends to follow the same pattern as the yields (see Table 4). The highest fertilizer applications are in the irrigated areas with both the irrigated HYV's and the local varieties using over twice that on the non-irrigated areas. But within the irrigated areas the application of fertilizers is not significantly different between HYV's and local varieties. The same is true of the non-irrigated areas. Since yields are higher for HYV's than for local varieties the HYV's show a greater response to fertilizer.

[6/] The utera pulse crop yielded an average of 60 Kgs. per acre with a range in yields of 30 to 100 Kgs. The 10 acres in the project area yielded 70 Kgs. Over 90 percent of the crop was harvested by the large farmers and 70 percent by the two largest. Even though this is not a typical utera crop it appears to add very little to farm income and is probably a luxury that most small farmers cannot afford.

Table 4. Average Fertilizer Use in Total Plant Nutrients, Wet Season Rice, 1970-71*

Total Village

Farm Size	High Yielding Varieties			Local Varieties			Total	Total	Grand
	Irrig.	Non-Irrig.	Total	Irrig.	Non-Irrig.	Total	Irrig.	Non-Irrig.	Total
	kgs/acre								
Small	22	5	18	27	11	15	24	10	16
Medium	23	15	21	21	9	11	23	10	13
Large	21	0	21	19	8	11	21	8	14
All Farms	22	9	21	21	9	11	21	9	14

Project Area

	High Yielding Varieties	Local Varieties	Grand Total
	kgs/acre		
Small	24	31	26
Medium	24	0	18
Large	7	n.p.+	7
All Farms	10	14	11

* Urea and super phosphate were the only two fertilizers used by the farmers. For a break down between N and P see the appendix, Tables 1 and 2.

\+ None planted.

As with yields, there is little significant difference in fertilizer use among the three sizes of farms. The small farmers apply the most fertilizer on local varieties while the medium and large farmers use the same quantity. In contrast, the small farmers applied the least to HYV's but the most for all varieties combined. Thus it would seem that the larger farmers do not have any easier access to fertilizer than the smaller ones.although in total quantity the large farms use considerably more fertilizer.

Based on yields, use of HYV's and fertilizer, it is clear that the irrigated land is the most productive. How much of the higher productivity is due to irrigation and how much to soil differences is not clear at this point. But the project area does not appear to differ in productivity from the rest of the irrigated area when the same amount of fertilizer is used.

Another factor in explaining yield differences is the amount of acreage transplanted.[7/] The project area has a slightly lower percentage of area transplanted than the total irrigated area. Sixty-seven percent of the irrigated rice is transplanted and 61 percent of the project area (see Table 5). In contrast only 9 percent of the non-irrigated rice is transplanted which drops the total cropped area transplanted to only 33 percent. This highlights the importance

---

7/ The acreage not transplanted was broadcasted and then ploughed ("biassi"). In the broadcasted paddy when the plants are 4" to 6" high a wooden plough is run through the fields. This is known as "biassi" which is supposed to help weed and thin the paddy stand.

Table 5. Percentage Rice Area Transplanted, Wet Season 1970-71

Farm Size	Total Village: High Yielding Varieties			Local Varieties			Total	Total	Grand
	Irrig.	Non-Irrig.	Total	Irrig.	Non-Irrig.	Total	Irrig.	Non-Irrig.	Total
	- - - -	- - - -	- - - -	- - - -	percentage	- - - -	- - - -	- - - -	- - - -
Small	70	58	67	35	9	15	54	14	30
Medium	58	68	60	48	9	14	54	14	23
Large	74	100	74	67	6	22	76	6	36
All Farms	72	70	71	62	7	20	67	9	33

Project Area

	High Yielding Varieties	Local Varieties	Grand Total
	- - - -	percentage	- - - -
Small	75	100	83
Medium	56	0	42
Large	61	n.p.*	61
All Farms	62	48	61

* None planted.

of supplemental irrigation in making transplanting possible.

As would be expected 71 percent of high yielding varieties are transplanted as compared to only 20 percent of local varieties. Within HYV's there is no difference between irrigated and non-irrigated. In contrast, 62 percent of the irrigated local varieties were transplanted and only 7 percent of the non-irrigated.

The large farmers have the highest percentage of transplanted rice except for the non-irrigated local varieties while the medium size farmers have the lowest percentage of transplanted acreage. This indicates that the large farmers have the edge in hiring and paying for the labor necessary to transplant. The small farmers probably do better than the medium size farmers because of more family labor relative to area planted.

Cost of Irrigation Project

The original cost estimate for installing the improved irrigation system was Rs 27,000 while the actual expenditure for constructing the main channel, the ten lateral channels and the two surface drains was approximately Rs 22,000. The project assumes that the farmers will construct the field channels at their own expense or with some state assistance. The field channels have already been laid out and all that remains is for the farmers to dig the ditches. Based on the Samalpur study Rs 6 per acre should cover the cost of digging the field channels /1, p. 20/. This would add Rs 160 to the project costs and raises the total cost to Rs 22,160 or Rs 833 per acre.

To calculate an approximate internal rate of return a ten-year life is assumed for the project. In addition, the costs should include the cost of technical assistance in designing and laying out the irrigation system. Since this is a pilot project the technical assistance is high relative to the acres involved as the engineers gain in experience along with the farmers. In expanding the results to other areas the cost of technical assistance should be lower.

If maintenance costs of Rs 5 per acre and the technical assistance costs are included, the cost per acre rises to Rs 934.[8/] This makes the internal rate of return 17.2 percent with net benefits of Rs 200 per acre.[9/]

8/

Estimated total cost of water use and management project.

Inputs	Costs
Construction materials	Rs 15,000
Labor	6,000
Technical assistance	2,000
Other	1,000
	Rs 24,000

9/

Estimated Internal Rates of Return for the Murethi Water Project*

Net Benefits Rs/Acre	Construction Costs Rs 12,000	Construction Costs Rs 24,000
	- - - - -percentages	- - - -
100	16.5	1.0
150	29.8	9.7
200	41.9	17.2

*Maintenance cost is estimated at Rs 5 per year per acre.

Should the annual net benefits from the project only amount to Rs 150 per acre the internal rate of return would be 9.7 percent.

The modest rates of return are due to the relative high cost of the irrigation system and suggest that without a subsidy the farmers are not likely to install similar improved irrigation systems on a large scale. Costs will have to be cut, possibly in half, before the farmers will be interested in installing the systems at their own cost. This cost reduction would raise the internal rate of return to 41.9 percent assuming a net benefit of Rs 200 per acre. Yet, if the increased net benefits are only Rs 100 per acre the internal rate of return drops to 16.5 percent. Thus the follow-up study will have to look very closely at net project benefits as well as means for cutting costs through alternative project designs.

Based on other studies of the impact of irrigation on wheat and paddy production, the range in annual net benefits of Rs 100 to 200 per acre seems reasonable [1, 5]. If the new system just allows the production of a dry season wheat crop the lower of the two figures is most likely. With additional rice production resulting from the improved irrigation system the net benefits could reach the upper level. But it is unlikely that the net benefits will reach Rs 290 per acre found in the Sambalpur projects where two or more crops are grown every year. In Murethi the second crop will never be a certainty, due to the variability of rainfall, the small capacity of the tank and the water requirements of the other villages irrigated by the tank.

Reviewing the project costs two things are apparent: (1) the material costs are almost two-thirds of the total costs and (2) the material and labor costs are primarily for the main channel construction and lining which serves a relatively small area. This leads to questions concerning means either of reducing the cost of the main channel or increasing the area it serves. If the same channel could irrigate 60 acres the cost might be considerably less per acre.

Continuing Restraints

Should the irrigation project be successful,the future development of Murethi Village will depend on several other restraints. One is just the maintenance of the improved irrigation system. Unless the village or IADP makes a special effort to maintain the irrigation channels and drainage ditches the project will not even last ten years. On the other hand, properly maintained it could last longer.

Second, the abysmal quality of cattle, which are fed mostly on straw, limits production. The cattle are of such poor quality that some may have a negative economic value. In addition the cattle have been allowed to roam during the dry season and the resulting crop damage has been a significant factor in preventing a dry season crop. The bullocks used in land tillage are usually the best of a poor lot causing the tillage operations to be under powered and slow. In most years this has an adverse affect both on the yields and total rice area planted.

The large farmers own 56.5 percent of the cattle while the small and medium size farmers own 23.5 and 20 percent respectively. The ratio of non-draft cattle to draft cattle is almost the same for all farm sizes (see Table 6). This ratio indicates that on the average between one and two non-draft animals are kept for each draft animal. The average area of rice land, 5.4 acres, per pair of draft animals is fairly reasonable although the small farmers average 2.6 acres per pair of draft animals. Even though the small farmers appear to be the group owning excess cattle relative to area farmed,the cattle improvement and control might well start with the large farmers since they do own over half of the cattle.

Third, credit can be critical in the adoption of purchased inputs but a high rate of defaulting on cooperative loans has significantly reduced it as a source of credit. The farmers also indicate that they are unable to obtain fertilizer from the cooperatives for timely application. On the positive side, the DMC/Dean Bank started making loans in the 1969-70 crop season and experienced excellent repayment on the almost Rs 8,000 loaned. In the 1970-71 crop season over two-thirds of the fertilizer was purchased on credit (see Table 7). Without this credit fertilizer use and rice production would probably drop substantially while an increased availability of credit, at the right time, would have a significant positive effect.

Although the medium size farmers purchased 91 percent of their fertilizer on credit the small farmers purchased only 58 percent on credit and the large farmers 65 percent. In terms of total credit used for fertilizer the large farmers had 67 percent while the medium size farms had 16 percent. This is slightly under their 70 percent and 18 percent share of rice land. The largest farmer obtained almost 20 percent of the total credit for fertilizers while he farmed 13 percent

Table 6. Cattle Owned by Farm Size, 1970-71

Farm Size	Draft Cattle	Total Cattle	Draft Cattle Per Farm	Total Cattle Per Farm	Ratio of Non-Draft Cattle to Draft Cattle	Rice Land per Pair of Draft Animals
	- - -	- - -	- - - numbers	- - -	- - -	- - acres - -
Small	39	99	1.4	3.5	1.5	2.6
Medium	29	84	1.5	4.2	1.9	5.4
Large	93	238	4.2	10.8	1.6	6.6
All Farms	161	421	2.3	6.0	1.6	5.4

Table 7. Fertilizer Purchases and Credit, Wet Season 1970-71*

Farm Size	Fertilizer Purchases: Total	Fertilizer Purchases: Per acre of rice land	Fertilizer Purchases: Credit purchases	Proportion of fertilizer purchased on credit
	- - - - - - - Rupees	- - - - - - -		- - -percentage - - -
Small	1,710	33	992	58
Medium	2,130	27	1,934	91
Large	9,174	30	5,979	65
All farms	13,013	30	8,905	68

* Figures may not add due to rounding.

of the rice land. If the largest farmer is dropped from the sample the percentage of fertilizer credit going to the large farmers group drops to 48 percent while they operate over 57 percent of the rice land. Total purchases of fertilizer also drop to Rs 23 per acre which is significantly below the average for small and medium size farmers. Given these figures it appears that the large farmer group has a good potential for increasing fertilizer use and production.

In general for all sizes of farmers a good potential exists for raising fertilizer use and yields on the irrigated land. One-third of the small and medium size farmers did not use any fertilizer in 1970-71. The average fertilizer use per acre is two-thirds below that found in the villages surveyed in Sambalpur for the wet season. In comparison with the improved Sambalpur villages the local rice varieties in Murethi yielded three quintals per acre less. It should also be noted that Murethi did not have the high insect damage which occurred in Sambalpur.

In terms of total credit used, fertilizer is only one of the claimants. Other agricultural uses (payments to labor, purchase of seed and insecticides, and land improvements) account for 53 percent of the credit, as compared to 27 percent for fertilizer and 20 percent for non-agricultural uses (see Table 8).

Fifty-two percent of all credit comes from the bank followed by the money lenders with 29 percent. Bank credit goes mostly into agriculture while credit from the money lenders goes for other agricultural and non-agricultural uses. The money lender is not an important source of credit for fertilizer. Cooperative credit is just about equally distributed among all

Table 8. The Percentage Distribution of Total Credit by Source and Purpose, 1970-71*

Farm Size	Fertilizer			Other Agricultural Uses			Non-Agricualtural Uses			Total Credit		
	Bank	Cooperative	Money Lender	Bank	Cooperative	Money Lender	Bank	Cooperative	Money Lender	Bank	Cooperative	Money Lender
Small	2	1	0	2	1	1	2	2	3	5	4	4
Medium	4	1	1	3	0	3	2	1	4	9	1	7
Large	15	3	a/	22	6	16	1	5	1	38	13	18
All Farms	21	5	1	27	7	20	5	7	8	52	19	29

* Figures may not add to totals due to rounding.

a/ Less than 0.5 percent.

three categories with the largest amount going for non-agricultural uses.

The distribution among the different farm sizes shows the large farmers receiving 69 percent of the credit in the village, over half of which comes from the bank. The small farmers obtain 13 percent of all credit with the medium sized farmers capturing the remaining 18 percent. The bank provides about half the credit to the medium size farmers but only 40 percent to the small farmers.

The large farmers used 90 percent of their credit for agricultural purposes while a quite different picture emerges from the small and medium size farms. The medium size farmers dissipated over a third of their credit for non-agricultural purposes while the small farmers squander almost half. The small and medium sized farmers employed more credit for non-agricultural purposes than they did for fertilizers.

One of the revealing aspects of these figures is the amount of bank and cooperative credit going for non-agricultural purposes. In fact, more cooperative credit is utilized for non-agricultural purposes than for fertilizer in all three farm sizes. The small farmers also employ more bank credit for non-agricultural uses than for fertilizer. The cooperative is not an important source of agricultural credit and without bank credit the village would face a considerable credit restraint. Even so less than 50 percent of all farmers utilize bank or cooperative credit and only 40 percent of the medium size farmers. The medium size farmers do not obtain even 400 Rs of total credit from the cooperative due to their high rate of defaulting. Considering the high use of bank and cooperative credit for non-agricultural purposes, the small and medium sized farmers are likely to become defaulters even to the bank. On the other hand, the large farmers do not seem to present much risk unless a bad monsoon brings crop failure.

Finally, the decline in acreage planted to HYV's is cause for concern. Farm size does not seem to influence the use of HYV's. The percent area planted to HYV's is not significantly different among the three farm sizes (Table 9). Irrigation is quite important with 57 percent of the irrigated area planted to HYV's as compared to only 4 percent in non-irrigated areas. The potential for expanding the acreage of HYV's seems substantial particularly in the non-irrigated areas.

Since farmers consume much of their own production, the decline may be due to less desirable eating qualities of the HYV's. Another reason for the lack of expansion may be the quality of seed available. In 1970-71 only one or two farmers purchased HYV's seed outside the village and the rest used seed produced locally which is of questionable quality. The current HYV's may also not be suited for the conditions of tank irrigation and the variable rainfall conditions of the non-irrigated areas. An effort should be instigated to determine why the acreage of HYV's dropped even though the yields and responsiveness to fertilizer is much better than for local varieties.

Table 9. Percentage of Rice Land Area in HYV's.

Farm Size	Irrigated	Non-Irrigated	Total
Small	56	11	29
Medium	62	8	21
Large	56	1	26
All Farms	57	4	25

Conclusion

This economic base study provides the needed guide for future measurement of economic growth in Murethi Village. The total irrigated area should be used as the basis for comparison since one large farmer, who did not use any fertilizer, biased the project area results downward. The impact of the pilot project will have to be examined carefully to determine the net benefits and to find means of reducing costs. Unless benefits are higher than suggested by past studies or project costs are lowered similar projects are not likely to be widely adopted without government subsidies.

Even if the irrigation project is expanded to the remaining irrigated area of the village additional restraints will slow economic progress. The improved irrigation system will have to be maintained which has been a difficult task in many other Indian irrigation projects. Some new institutional arrangements may be needed to solve the problem. The cattle population needs improvement and control to provide adequate animal power and to prevent damage of the dry season crop. The small and medium size farmers may not have adequate resources to employ the available credit without a real risk of defaulting. Less than 46 percent of these farmers utilized either bank or cooperative credit in 1970-71. Finally, the factors causing the decline in use of HYV's should be determined and corrected if possible.

References

[1] B. B. Batra and K. William Easter, High Returns from Field Channels in Irrigated Indian Villages, University of Minnesota, Department of Agricultural and Applied Economics, Staff Paper P72-24, September 1972, 29 p.

[2] Lance J. Colyar, A Rainfall Study in Raipur District, IADP, New Delhi, mimeograph, June 1967, 14p.

[3] Work Plan for Adoptive Research - cum - Training Project on Water Use and Management, Raipur, The Ford Foundation, New Delhi, Mimeograph, November 1969.

[4] Marshall M. Bouton, Preliminary Report of IADP Form and Labour Survey for Raipur and West Godavari Districts, The Ford Fondation, New Delhi, August 1969, Mimeograph, 62 p.

[5] Thomas F. Weaver, Irrigation Evaluation under Monsoon Rainfall Patterns, (A Case Study of Raipur District, Madhya Pradesh, India), Cornell International Agricultural Development Bulletin 10, (Cornell University, Ithaca, New York, 1968) 54 p.

[6] "Agricultural Statistics, Madhya Pradesh 1950-71" Directorate of Agriculture, Madhya Pradesh, Bhopal, 1972, 86 p.

Appendix Table 1. Average Fertilizer Applied in Plant Nutrients by Variety, Wet Season Rice, 1970-71.

Total Village

Farm Size	High Yielding Varieties						Local Varieties					
	Irrigated		Non-Irrigated		Total		Irrigated		Non-Irrigated		Total	
	N	P	N	P	N	P	N	P	N	P	N	P
	kgs/acre						kgs/acre					
Small	11.4	10.4	0	4.9	8.9	9.2	19.4	7.9	8.1	3.1	10.8	4.3
Medium	14.7	8.5	8.5	6.3	12.9	7.9	9.7	11.6	5.6	3.7	6.1	4.6
Large	12.4	9.0	0	0	12.2	8.8	12.2	7.2	5.2	2.8	7.1	4.0
All Farms	12.6	9.1	4.2	4.8	11.8	8.7	12.8	7.7	5.6	3.0	7.3	4.1

Project Area

	High Yielding Varieties		Local Varieties		Grand Total	
	N	P	N	P	N	P
	kgs/acre					
Small	11.5	12.0	12.1	18.4	11.7	13.9
Medium	15.0	9.0	0	0	11.1	6.7
Large	4.1	3.0	n.p.	n.p.	4.1	3.0
All Farms	6.0	4.4	5.7	8.6	6.0	4.7

Appendix Table 2. Average Fertilizer Applied in Plant Nutrients by Irrigation, Wet Season Rice, 1970-71.

Farm Size	Total Village					
	Irrigated		Non-Irrigated		Grand Total	
	N	P	N	P	N	P
	---------- kgs/acre ----------					
Small	14.9	9.3	7.2	3.3	10.3	5.7
Medium	12.8	9.7	5.8	3.9	7.5	5.2
Large	12.3	8.2	5.2	2.8	8.4	5.3
All Farms	12.7	8.5	5.6	3.1	8.5	5.3

Appendix Table 3: Credit by Source and Use, Wet Season, 1970-71.

Farm Size	Fertilizer			Other Agriculture*			Non-Agriculture		
	Bank	Cooperative	Money Lender	Bank	Cooperative	Money Lender	Bank	Cooperative	Money Lender
	- - - - - - -	- - - - - - -	- - - - - - -	- - - - - - -	Rupees	- - - - - - -	- - - - - - -	- - - - - - -	- - - - - - -
Small	596	396	0	484	397	370	681	553	889
Medium	1,443	172	319	900	0	864	700	200	1,223
Large	4,783	1,061	135	7,363	1,843	5,416	302	1,499	474
All Farms	6,822	1,629	454	8,747	2,240	6,650	1,683	2,252	2,586

* Includes credit for payments to labor, purchase of seed and insecticides and land improvement.