RESPONSES TO, AND IMPACT OF, H.Y.V. RICE ACCORDING TO LAND SIZE AND TENURE IN A DELTA VILLAGE, ANDHRA PRADESH, INDIA

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I. FORMULATION OF THE PROBLEM

THE EARLY optimism[1] that what is required for agricultural growth above all is concentration on specific questions relating to the mechanism of the technological change required in each case and supply of the necessary inputs[2] is giving place to a more sober assessment of the constraints to growth and the economic and social implications of the new technology. There is a much better appreciation of the environmental constraints. The point of view of "environmentalists" is ably presented in relation to changes in rice farming by Mangahas and Barker in an article presented at the International Conference of Agricultural Economists held at Minsk [1, p. 398]. The authors attribute the low response of rice farmers to the new technology as compared to wheat growers to the relatively unfavorable set of environmental conditions facing rice. Rice is subject to floods and droughts, to high humidity during the main growing season and to more severe attacks by pests and diseases. This led to a recognition of complementarity between infrastructure and investments in research and development of new varieties. There is also a growing scepticism of the assumption that primary emphasis on research and development could provide a relatively inexpensive route to rapid growth of agriculture in developing economies [5]. Institutional changes too which were considered only of marginal importance, when the experience with the use of technology on the farmer's fields was still limited, are now given a more prominent place by economists and policy makers.[3] Mangahas and Barker, however, underplayed the importance of institutions as critical to growth. To quote them:

The effect of owner operatorship is generally productive but rather small. From the

We express our appreciation of the computational assistance of Shri P. Rajith Kumar.

1 See [3]. The theme of this paper is that technology can be more revolutionary than any isms. Theodore Schultz, a pioneer among "technology crucial" advocates considered that the surest route to progress is to develop supply and teach how to use a more profitable set of factors [18, p. vii].

2 For a criticism of the factual basis as well as the influences of "technology crucial" approach, see [16].

3 The literature on this aspect is quite large. The most passionate advocate of institutional changes in India is Wolf Ladejinsky. See [6] [11].

view point of land reform, it appears that the transfer from share tenancy to owner operatorship *per se* is of lesser importance than such other aspects of the reform programme as irrigation and extension system to the tenant. Farm size was found to have a very small effect, supporting the contention that no minimum farm size is necessary for new varieties to be economically acceptable. [1, p. 405][4]

These conclusions are based on a study of the responses of sample farmers in Philippines, and quite obviously, even the authors will not hold them applicable to all agro-economic situations. It is also important to recognize that the policy implications drawn by them have validity even in the Philippine context, only under the assumption that in the absence of land reform, a more adverse distribution of incomes will not turn into a constraint to growth. Therefore responses of different size and tenure groups to new technology, and economic and social effects of the latter need to be examined for well-defined agro-economic situations.

Village studies in well-defined settings have two advantages over sample studies. Firstly, they permit analysis in depth since the analyst gains better insights into the working of different complex forces when the unit of observation is spread over a small area. Secondly, the influences of other factors, like environment, the nature of extension administration, etc. which need to be separated when a sample spread over large area is chosen, is minimum and responses to the variable under examination could be studied with more confidence. An attempt is made in this paper to use the data of Pedapulleru village[5] to test the inferences of Mangahas and Barker in relation to a defined setting. The village chosen, Pedapulleru, West Godavari District, Andhra Pradesh, India, is a canal irrigated rice village with no other crop either in wet or dry season and has fair representation of all the size and tenure groups. No significant differences are reported in respect of soil, drainage, and water supply conditions on farms either between tenure or size groups. Whatever environmental disabilities are observed, like inadequate drainage, etc., are shared by all groups, and are not size or tenure specific.

All the 185 cultivators in the village are studied. They are classified into six size groups and four tenure groups[6] for purposes of observing the variations in response to new technology. The analysis is presented separately for each season

4 Mukherjee argued on the basis of P.E.O. data that tenancy is not a variable that matters for adoption of new technology. See [7].

5 All the cultivators in the village were surveyed in July 1972, and details relating to size, tenure adoption of H.Y.V. cultural practices, yields, etc. were obtained separately for *kharif* traditional, *kharif* H.Y.V., *rabi* traditional, and *rabi* H.Y.V. for the agricultural year 1971–72. A listing schedule covering all the residents in the village with occupational details preceded the farm survey. The survey was financed by the International Rice Research Institute, Manila.

For a good description of the agro-economic situation of the district in which the village is situated, see [4, pp. 47–80].

6 The data are studied by six size groups and four tenure groups, though the analysis here is presented by two size groups and two tenure groups for some analysis. The six size groups are: A—less than one hectare; B—one hectare and more but less than three hectares; C—two hectares and more but less than three hectares; D—three hectares and more but less than four hectares; E—four hectares and more but less than six hectares; F—more than six hectares. The four tenure groups are: I—pure owner cultivator; II—owner cultivator cum rentier; III—pure tenant; IV—owner cultivator cum tenant.

and pertains to 1971–72, *kharif* and *rabi*.[7] The first part of the paper presents findings on response to new technology, and the second the economic and social impact of technology by size and tenure.

II. RESPONSES TO NEW TECHNOLOGY

The degree of response to new technology is judged by number either totally or partially shifting to H.Y.V., area under H.Y.V., shift to nontraditional inputs, etc.

H.Y.V. growers in *kharif* season formed only 12.09 per cent as compared to 45.03 per cent in *rabi*. *Rabi* rates exceeded *kharif* rates in all (a) size and (b) tenure groups (see Table I). It is well known that environmental constraints are more

TABLE I
H. Y. V. GROWERS TO TOTAL IN EACH GROUP BY SIZE AND TENURE

(%)

Size / Tenure	*Kharif*			*Rabi*		
	Below 4 Hectares	4 Hectares and Above	Total	Below 4 Hectares	4 Hectares and Above	Total
Owners	3.03	28.57	14.75	35.29	67.31	51.46
Pure tenants	4.00	20.00	6.67	31.58	30.00	31.25
Total	3.45	27.27	12.09	33.71	61.29	45.03

severe in *kharif* than in *rabi*. In this respect, there is no difference in the data observed by us and that analyzed by Mangahas and Barker. But the similarity stops here. Even in the seventh year of progress of H.Y.V., significant differences are noticed between the rate of adoption of the farmer with four hectares and above and the rest.

Though inputs are perfectly divisible, adoption is influenced by the perception of, and the ability to take the risk. Size has a bearing on both these factors. Environmental constraints, though shared by all, produce varying reactions depending upon size. What comes out most clearly in the data is that farmers above a particular size level with more investable surplus and therefore greater ability to undertake risks show higher rates of adoption. Thus size continues to be a constraint, in spite of what is said to the contrary, though its influence is less in a season with less degree of environmental risks. The data confirm also the evidence already accumulated that the rate of early adoption as well as the proportion of those who used H.Y.V. at one time or another are significantly high among the big farmers as compared to others [10]. This applies more to *kharif* than for *rabi*.

Tests of association between size and adoption by applying χ^2 revealed that size of four hectares and above has a significant association with adoption. This held good even when influence of size on adoption within owner group is separately considered. When association between size and adoption is tested for two size groups below four hectares (for *rabi* season only), viz., (a) below two hectares, and

[7] *Kharif* is the wet season and *rabi* is the dry season.

TABTE II

χ^2 VALUES AND SIGNIFICANCE TESTS: ADOPTION OF H.Y.V.

	Values		Remarks about Significance
	Kharif	*Rabi*	
Size (ignoring tenancy)	22.46	11.23	Significant at 1 % level
Tenancy (ignoring size)	2.47	5.41	Not significant
Tenancy within 4 hectares size group	0.08	0.14	Not significant
Tenancy in 4 hectares and above size group	0.32	4.92	Not significant
Owners with regard to size	15.72	10.56	Significant at 1 % level
Tenants with regard to size	3.49	0.01	Not significant
Below 2 hectares and 2 hectares above (ignoring tenancy)	—	0.06	Not significant

Note: χ^2 (1, 0.01)=6.64.

(b) two hectares and above, no significant association is found suggesting the absence of influence of size below a particular level (see Table II).

Tenure is found to have no association with adoption. This is found to be true even when association between tenure and adoption within each size group is considered. The result becomes meaningful when it is recognized that the system of tenancy under H.Y.V. is different. Decision-making on variety to be adopted is with the landowner and nontraditional inputs are financed by him. In other situations one cannot be sure of similar results.

The results are not significantly different even when they are judged by proportion of area under each group. Even after seven years of progress of H.Y.V. only less than one-fourth of area cultivated in both seasons is under H.Y.V. Percentage of area under H.Y.V. is only 8.77 in *kharif* as against 44.40 per cent in *rabi*. The district picture is not far dissimilar. Farmers with four hectares and above retain their advantage compared to the rest in both the seasons. Size exercises its influence on adoption, and its influence is more prominent on the owner group than on the tenant group (see Table III).

Two inputs which are crucial to the success of high yielding variety program,

TABLE III

H.Y.V. AREA TO TOTAL CULTIVATED AREA WITHIN EACH GROUP BY SIZE AND TENURE

(%)

Size / Tenure	*Kharif*			*Rabi*		
	Below 4 Hectares	4 Hectares and Above	Total	Below 4 Hectares	4 Hectares and Above	Total
Owners	1.51	10.02	8.77	32.81	51.06	48.43
Pure tenants	2.78	18.12	8.77	27.68	25.00	26.53
Total	2.08	10.69	8.77	30.39	48.42	44.40

Note: In *kharif*, tenants were found to put a higher proportion of area under H.Y.V. than owners.

viz., chemical fertilizers and pesticides alone are considered. The measures set up are (1) the proportion using in each group and (2) the level of use per hectare. These are examined by size and tenure for H.Y.V. and traditional growers separately for each season.

The use of N was widespread in the area even before the introduction of H.Y.V. More than 60 per cent reported that they used N even earlier to 1965–66. This process has been accelerated subsequent to 1965–66 and is found common on all farms even in respect of traditional varieties, use of P is not so universal. It is much less common for *kharif* traditional than for *rabi* traditional. A larger proportion of H.Y.V. growers use P than traditional growers. Use of K, however, is exceptional.

Size is found to have no influence on the proportions using N. Even tenure has no perceptible influence. The pure tenants, however, record a slightly less proportion than the owners in respect of use of P and K.

The influence of environment on the level of use of N per hectare is seen both on area under traditional as well as H.Y.V. The use of N per hectare of traditional in *rabi* season is 79.05 kgs per hectare as against 36.65 kgs per hectare in *kharif* traditional. A similar relationship is seen in respect of H.Y.V. area, the level being 120.49 kgs per hectare in *rabi* as against 64.35 kgs in *kharif*. Use of N does not show any consistent relationship with size. In all the groups the level is closer to, or even more than the recommended dosage.

Level of use of P also shows significant variations between seasons, it being much more in *rabi* than in *kharif*. The smaller size groups record lower levels as compared to the others. Level of use of K is very low on all farms, and small farmers use much less than others.

In conclusion, while the influence of environment on the level of fertilizer use is obvious, one could see that small farmers use less of those inputs which are not yet popular.

The facts give a similar picture when the data are classified by tenure. Use of N, a practice universally accepted, is no less than that of others on tenant farms, either traditional or H.Y.V. But in respect of use of K the tenants lag behind others, again confirming that even within the same environment lags could be expected depending upon size and tenure even after years of progress of technology.

The advances in the use of pesticides are more spectacular since the introduction of H.Y.V. program. Only one-eighth of the current cultivators reported use of pesticides earlier to 1965–66, in *kharif* season. But more than 40 per cent used in *rabi* even before this period. Since then, pesticide use has become almost universal bordering on 100 per cent for *rabi* both for the traditional and the H.Y.V. crop. Pesticide use is less essential for *kharif* traditional crop, and only 18.54 per cent of the total cultivators used it. For *kharif* H.Y.V. the proportion using is 77 per cent. Examining pesticide use in *rabi* season, in which it is more common, the smaller size groups and the tenant groups use less, both for high yielding and traditional varieties. The pattern is consistent. The more recent input is used with a lag by tenants and small farmers and in less quantities.

The variations in the use of inputs between size and tenure groups are of course less significant within a season than between. While this fact is well taken, the

policy inference that land reform per se is of lesser importance than irrigation, extension system, etc. does not automatically follow.

The new technology which helped to give a boost to yields (see Table IV), places the person with more investible surplus at an advantage. At any rate the relative advantage of the small man who has more labor surplus has considerably reduced in the context of new technology. The inverse relationship between yield levels

TABLE IV

YIELDS PER HECTARE IN KGS BY SEASON FOR H. Y. V. AND TRADITIONAL

	Kharif		*Rabi*	
	Yield	Values (Rs).	Yield	Values (Rs.)
H. Y. V.	4,051.29	2,633	5,441.25	3,293
Traditional	3,057.92	1,865	2,968.97	2,019
Difference	993.37	768	2,472.28	1,274
Difference as a percentage over traditional	32.49	41.18	83.27	63.10

and size observed in the farm data of the pre-technology era, and which provoked a lively controversy in the academic circles, is not found in any pronounced manner, even in respect of traditional varieties. The opposite conclusion also cannot be firmly established. In *rabi* H.Y.V., in which there is a fair representation of all groups, big farmers show a trace of superiority in yield levels over others. The differences in the yield levels between the tenure groups are not obvious.

The big farmers led the new technology, are ahead of others in terms of rates of adoption and show better use of the package of inputs. It might then be inferred that rapid progress of technology could be fostered by concentrating on the big farmer. This, however, will be a hazardous leap from partial facts to dangerous policy since welfare implications of new technology could be neglected only at a great social cost.

III. ECONOMIC AND SOCIAL EFFECTS OF NEW TECHNOLOGY

A. *Changes in Agrarian Structure*

In considering the economic and social effects, a study of changes in the agrarian structure of the economy should be given priority since the distribution of ownership and of control over land influences profoundly the distribution of income. This is done by comparing the present position of village with the position just on the eve of introduction of new technology. There are inherent limitations in the method. Firstly the analysis is confined only to the current residents of the village and does not cover those who left the village for better or for worse. Secondly, it is difficult to separate the influence of technology from others. But these are not very serious limitations for the area under consideration. Out-migration and in-migration are negligible during the period under consideration. This is an exclusively rice village, and the major change since 1965–66 is the introduction of H.Y.V.

We shall start with an analysis of changes in the structure of rural economy, the rural residents being treated only under two categories, viz., cultivators and noncultivators. The latter group include all those who do not report possession of land. All the residents in the village are classified by their attachment to land in 1964–65 and 1971–72. Judging the rural economy in this manner reveals a remarkable stability between the two points of time. Proportions under two categories show only negligible changes, though movements are in evidence from one group to another between two points of time. We tried to identify the people that move from one category into another. The movement was by and large confined to the tenant group. Some former tenants became landless laborers and a similar number of landless laborers became tenants, these movements indicating the flux behind an apparent stability.

Examining the group of cultivators, who did not show any change between the two points of time, for tenurial changes within, the large majority, 160 out of 171 do not record any change. There was only one sole case of a former tenant turning into an owner. This shows that within the specific socioeconomic environment under examination, upward movement of former tenants into owner group is hardly possible.

The proportion affected by changes within the extent of area operated is far more significant. Around 40 per cent of the cultivators report changes in size, the number reporting upward and downward movements being equally distributed. Those reporting downward movements were more in number in the bottom as well as in the top groups. The picture became much clearer when cultivators reporting changes in size were identified by tenure groups. Majority of those reporting changes in size were found in tenant groups, and not in owner groups. The conclusion is that behind the apparent stability there is considerable flux, and this is caused mainly by the shifts in area under tenancy from one class of people to the other, suggesting insecurity of tenure.

The stability in the distribution of ownership of land is seen in the number of sale and purchase transactions as well as the area involved in these transactions over the seven year period. There were only eight buyers and twelve sellers. Reported purchased area was only 10.00 hectares and more than half of it was within the group cultivating six hectares and more. The sale recorded by small cultivators was also insignificant. Compared to the small the big farmers showed more sales. But purchase transactions show little evidence of gains by small owners even though threats of radical ceilings have been there for some time. Thus past trends do not show that the operation of land market will ensure a shift of land ownership to the small, even if gradual, at any significant scale. At best threats of radical ceiling had the effect of freezing the distribution of landed wealth at pre-technology position.

Does the lease market at least facilitate a shift of control over land to the small? It does, if the big owners are found to lease out, and the resulting distribution of operated area is much less uneven than the distribution of owned area. A substantial majority of the big owners do operate their lands, and pure rentiers are much more common among the small owners than among the big. Among the big

owners, the minority who do, lease out only in part. Though the lease market enables landless to gain control over land its effect in relation to a wider diffusion of land among rural residents is not significant. The cultivators among the rural residents form a minority, i.e., 42.37 per cent and the substantial majority among the rest are landless laborers.

In considering the agrarian structure of an Indian village, there is another factor, viz., caste, which may be of less importance in other situations. Ownership and control of land by a caste group which does not entertain matrimonial relationships with members from other caste groups even if they were to be from the same economic strata, superimposes an economic inequality over social inequality and makes inequality more intolerable. For this reason, diffusion of control over land between different caste groups becomes relevant. The "dominant" caste in the village is Kshatriya since it controls the substantial proportion of village land.[8] Size of leased in area is identified by the caste of the tenant. The bigger tenants are found to be drawn more from the Kshatriya community than from other groups. There is some element of diffusion of land to others. But it is small.

The analysis of extent of leased in area by extent of owned area is also revealing. Pure tenants from the majority,[9] sixty-three out of ninety-eight, and account for 16.98 per cent of leased in area to total cultivated as against 11.40 per cent of the owner-cum-tenants. The owner-cum-tenants are found to be a mixed bag and drawn from both small and big owners. To the small owners leasing in provided an opportunity to make their holdings viable. The character of tenancy of big owners is of a different type. The leased in area reported by them belonged to their kith and kin who live in other places, and in some cases the tenanted land happened to be area given in the form of dowry to daughters. To this extent, the lease market did not help diffusion of control over land among wider groups. In conclusion, while there is evidence of control over land being shared with non-owning groups, its effect in bringing out a better diffusion of control over land is limited.

B. *Changes in Rental Market*

Diffusion of control over land might help the poor in a land scarce economy. But benefits of diffusion depend upon the price paid for gaining control. A study of rent, therefore, becomes relevant. Two types of rental payments are in practice in the village, viz., share rents, and rents fixed in kind. Rental systems vary between the *kharif* and the *rabi* seasons. For traditional varieties the most common practice in *kharif* is payment of a fixed contracted amount of produce in kind, and in *rabi* a contracted share of the gross produce.[10] When the rent is fixed in kind, all the

8 For an exposition of the concept of "dominant caste," see [19].

9 This is in contrast with some findings based on sample studies which show that the proportion of pure tenants and extent of area under pure tenancy is small. Pure tenancy is in a much more disguised form and possibly does not get reported in sample studies. See [9].

10 These differences between *kharif* and *rabi* in respect of systems of rent payment need explanation. Crop in *kharif*, traditional, is subject to less environmental risks. It is a long duration one. Crop in *rabi*, traditional, is of a shorter duration as compared to *kharif* traditional, involves more cash costs, while fixed rent is common in *kharif*, share rent has become universal in *rabi*.

cultivation expenses except land revenue are borne by the tenant. When it is paid as a share of gross produce only costs on fertilizer and pesticides are borne by the landowner proportionate to his share in the gross produce. Since 1965–66 there is a slight swing towards share tenancy, even in respect of traditional varieties in *kharif*. In *rabi* it was always a share of produce, and it continues to be so. The major change is now in the level of share paid to the landowner when H.Y.V.'s are grown. When traditional varieties are grown a share of two-thirds of the produce is given to the landowner only in a minority of cases. But if the tenant chooses to grow H.Y.V. the landlord should be given two-thirds of the share, and in a majority of the cases he does.[11] Thus with increasing production potential rents are revised upward, and the rental market does not automatically ensure the flow of benefits of technology to the tenant. Decision-making also shifts to the landlord more and more. He decides the variety to be grown, supplies a major part of the capital for nontraditional inputs, and provides the finances to the tenant. The tenant becomes indistinguishable from a permanent farm servant and tenancy system is nothing but a convenient arrangement under which a big owner who leases out in part relieves himself from the burdens of labor management while performing the major entrepreneurial functions. The new role played by the landowner is in a very large measure attributable to changes in technology, and this provides an explanation for the observed similarity in the level of inputs as well as yields between owner and tenant groups.

Rents paid per hectare are studied for each season and within each season, for traditional and H.Y.V. separately. Rents paid for H.Y.V. under *rabi* are more than double the rents paid under traditional. Even in *kharif* rents paid for H.Y.V. are more. Quantum of rent paid under share rents is found to exceed that fixed in kind. If allowance is made for the sharing of expenses between the landowner and the tenant, the gain of the landlord in the total produce under the two arrangements is more or less similar. Considering *rabi* season and pure tenants only the yield is 27.21 quintals per hectare for local as against a rent of 14.44 quintals. The yields under H.Y.V. is 57.27 quintals as against a rent of 37.05 quintals. By a shift, the tenant gets an excess of 30.06 quintals per hectare and pays 22.61 quintals more by way of rent, thus gaining an excess of 7.45 quintals. Even after making allowances for excess cash costs the tenant is a gainer. But if relative share are examined, more than three-fourths of the excess produce is got by the landowner and only one-fourth by the tenant making the relative distribution of income much more uneven.

[11] Francine Frankel's accounts of other areas in the district conform to this. See [4].

Commenting on C. Hanumantha Rao's thesis that crop sharing arrangements are extensive under relative economic certainty and fixed contractual payments where the degree of uncertainty is high Bhagawati and Chakravarti write that Rao's thesis would lead to further refutable hypothesis that as technological possibilities for application of new inputs, such as better seeds and fertilizers are introduced, share cropping would give way to other forms of tenurial relationships. With the introduction of these new techniques in India during the last few years, such an empirical test should be feasible [2, pp. 54–55].

Facts do not support Rao's contention. There is a shift towards share tenancy, entrepreneurial functions being shifted to landowner.

For an evaluation of Land Reform Legislation in Andhra Pradesh, see [15] [13].

C. *Credit Market*

The lease market cannot be expected to operate in favor of tenants in a land scarce, labor surplus economy. But could we expect at least the institutional credit agencies set up mainly to promote the interest of the weaker sections to act in their favor? The village has a co-operative credit society, which by business standards, is functioning well and its business has considerably increased since 1965–66. Credit reported to have been received from institutions is studied by size and tenure. What comes out prominently is that the top group has obviously more than its share in the total number of cultivators, and more than its share in the area too. The pure tenants who account for 34.05 per cent of the cultivators and 16.95 per cent of the area operated get almost nothing from the institutional sources. Among the owner groups the owner-cum-rentiers whose average size of holdings is much more than others get credit far more than their proportion in the total area.

The results should not be surprising. The power within the co-operatives is wielded by the dominant caste group, and in it the bigger group. The power within the *panchayat* is also wielded by the same group. The argument runs that it is hazardous to the institutions to lend to tenants who cannot offer any security. The land owner could get it and pass on to his tenant. The small owner is also not considered a safe investment.[12]

The borrowers form 59.10 per cent, 78.40 per cent, 80.90 per cent, and 55.60 per cent respectively among H.Y.V. growers (*kharif*), traditional growers (*kharif*), H.Y.V. growers (*rabi*), and traditional growers (*rabi*). Of the borrowers the corresponding proportions of those reporting credit from institutional sources are 46.15 per cent, 24.26 per cent, 34.55 per cent, and 9.23 per cent respectively. The role of institutions is much less significant in *rabi* than in *kharif* season, and less significant for traditional than for H.Y.V. It is obvious that institutions continue to account only for a minor proportion of the credit requirements of cultivators. Their share by size and tenure shows a general bias in favor of the big among the H.Y.V. growers.

It should not be inferred that tenants and small owners are starved of credit. They get credit, but at a higher cost, i.e., generally double the rates of institutional credit while the big appropriate the cheap credit supplied by institutions. The tenants are apparently provided interest free loans by the rentiers, but institutions by closing their access weaken the bargaining position of tenants vis-à-vis the owners in the rental markets. For the small owners, the higher cost of loan capital reduces the profitability from the new technology.

D. *Product Market*

The product market does not apparently show any discrimination against the tenant and small cultivator. Prices of paddy received are examined by size groups, and by tenure groups for three time periods of sales, viz., (1) immediately after harvest, (2) not immediately but less than a month after harvest, and (3) more than a month after harvest. Within each time period prices did not vary significantly

12 Analysis of Muthiah based on the data of Agro-Economic Centres for several districts shows similar results [8].

either between size or tenure groups. But when the weighted price received is examined by size and tenure, one could detect that pure tenant received less price. His sales was immediately after the harvest. By size group, no significant differences are noted between the small and the big, indicating that the proportion of sales by time period did not differ by size. A caution, however, is necessary. The investigation was conducted in the month of July 1972, seven months after the *kharif* traditional crop was harvested and two to three months after the *rabi* traditional crop was harvested. The big farmers had still large stocks of *kharif* traditional crop with them which they sell only just before the next *kharif* harvest. This will facilitate them to get a much better price. When supplies fall short of demand and with a guaranteed minimum price being operated, marketing is not found to be a constraint even in respect of small farmers and tenants, though the differential in respect of traditional varieties and H.Y.V. varieties continues. The weighted prices of H.Y.V. *rabi* paddy are Rs. 60.53 per quintal while that of traditional is Rs. 68.09. But in *kharif*, with the shift from I.R.8, a coarse variety (considered inferior to the traditional variety, viz., Akkullu) to Mashuri, a finer variety, price differential is not only reduced but H.Y.V. prices are found to be higher than for traditional. In fact this has given a boost to shift from Akkullu, the traditional variety, to Mashuri.

E. *Input Market*

In the input markets in which scarcity in relation to demand is more, the smaller farmer and the tenant experience greater difficulties. This is indicated by the higher proportion of people reporting fertilizers, pesticides, and tractor service as constraints (see Tables V and VI).

In brief, rental market, market for loanable funds, and product and input markets could not be expected to work in favor of the small farmer and the tenant.

TABLE V

PERCENTAGE OF CULTIVATORS TO TOTAL IN THE GROUP REPORTING VARIOUS INPUTS AS CONSTRAINTS TO GROWTH BY SIZE GROUP

Constraints\Size	A	B	C	D	E	F	Overall
Kharif H. Y. V.							
Fertilizer availability	100.00	100.00	—	100.00	66.67	33.33	50.00
Credit	nil	50.00	—	nil	33.33	nil	9.09
Pests and diseases	100.00	50.00	—	100.00	66.67	93.33	86.36
Tractor service	100.00	50.00	—	nil	66.67	13.33	27.27
Rabi H. Y. V.							
Fertilizer availability	60.00	92.31	60.00	42.86	71.43	25.81	50.00
Credit	60.00	15.38	20.00	nil	42.86	9.68	17.65
Pests and diseases	100.00	100.00	100.00	100.00	100.00	96.77	98.33
Tractor service	60.00	76.92	20.00	71.43	42.86	22.58	42.65

Note: — indicates no growers.

In a rural structure marked by inequalities, all these tend to discriminate against the small farmer and the tenant. Since the new technology could be taken advantage of better by those with more investable surplus it contributes to sharpen the existing

TABLE VI
PERCENTAGE OF CULTIVATORS TO TOTAL IN THE GROUP REPORTING VARIOUS INPUTS AS CONSTRAINTS TO GROWTH BY TENURE

Constraints\Tenure	I	II	III	IV	Overall
Kharif H.Y.V.					
Fertilizer availability	50.00	—	100.00	40.00	50.00
Credit	—	—	25.00	20.00	9.09
Pests and diseases	80.00	66.67	100.00	100.00	86.36
Tractor service	20.00	33.33	25.00	40.00	27.27
Rabi H.Y.V.					
Fertilizer availability	37.04	—	100.00	45.00	50.00
Credit	7.41	—	6.67	45.00	17.65
Pests and diseases	100.00	100.00	100.00	95.00	98.53
Tractor service	44.41	16.67	60.00	35.00	42.65

inequalities even though in absolute terms some benefits are got by small farmers and tenants. Then the entire burden of providing relief from a growing inequality is placed on the labor market.

F. *Labor Market*

The new technology could mitigate the adverse effects of agrarian structure via the labor market by (a) enabling the labor to earn a higher real wage, and (b) by enabling them to get more employment.[13] We do not have time series of wages for the village. We used the time series of wages of agricultural labor district-wise published in the season and crop reports of the state government. The index of money wage for males shows a rise from 100 to 115 between 1958–59 and 1964–65 while during the same period the index of rural retail prices show a rise of 100 to 130 indicating a fall in real wages during this period. The index of money wages had risen from 115 in 1964–65 to 184 in 1968–69 while the index of retail prices rose to 183, the base for both being 1958–59. The period after 1964–65 could thus be seen to be better as compared to the period 1958–59 to 1964–65, though over the period as a whole real wage of laborer remains constant [14]. Since 1968–69 there is a further spurt in the prices of wage goods, and cash wages have shown an increase. While most labor households as well as the cultivator households in the village report an increase in the cash wages they do not report an increase in real wages except for few operations (Table VII). In situations where there is a labor surplus, the pressure on the labor market induced by new technology could be seen only in the level of employment but not on real wages. It is to this we have to turn to discover any beneficial impact of technology. Upward levels of employment could be achieved as a consequence of new technology in two ways: (1) The new technology may increase the intensity of cropping since it shortens the duration of the crop period; (2) For each crop taken labor requirements are more as a consequence of shift to H.Y.V. The first result is not automatic but depends upon

[13] C. H. Rao examined the impact of green revolution on labor's share in output and concluded that "The experience in the IADP districts and with IR-8 rice in West Godavari does suggest that the relative share of labor may decline as a result of green revolution." See [17].

TABLE VII
SAMPLE LABOR HOUSEHOLDS

Operation	Reporting Increase		Reporting Decrease		Reporting No Change		Total	
	Wages	Employ-ment	Wages	Employ-ment	Wages	Employ-ment	Wages	Employ-ment
A. Preparatory nurseries	nil	nil	1	nil	14	15	15	15
B. Puddling	nil	nil	6	13	9	2	15	15
C. Transplantation	nil	nil	2	2	13	13	15	15
D. Weeding	nil	5	13	nil	2	10	15	15
E. Fertilizer application	11	15	1	nil	3	nil	15	15
F. Pesticide application	14	15	1	nil	nil	nil	15	15
G. Harvesting	6	10	1	nil	8	5	15	15
H. Bundling	3	1	1	nil	11	14	15	15
I. Threshing	7	nil	2	nil	6	15	15	15
J. Transportation	3	nil	6	nil	6	15	15	15
K. Others	3	nil	1	nil	11	15	15	15
L. Other than agriculture	3	nil	1	nil	11	15	15	15

Note: These are drawn from landless labor households in the village on a random basis reporting changes in real wages and employment for males as compared to 1964-65.

the availability of water. In the village under examination water is regulated by the public canal system and is beyond farmers control. A second crop could be taken even when canal water is not supplied by tapping the ground water resources. In this village no attempt in this direction has been made even by the big farmers. Then increased employment is possible only due to the second effect. We have not collected quantitative data relating to this. But we could build up a picture from the data available in other surveys.[14]

(Man-days per hectare: 1968-69)

	Participant Local	Participant H.Y.V.
Kharif	136	164
Rabi	191	220

Note: Human labor inputs, both family and hired, in West Godavari District are given.

Labor inputs for H.Y.V. are more for high yielding varieties, and show an excess of 20 per cent in *kharif*, and around 16 per cent in *rabi*. But the impact of this rise on overall employment level depends upon the extent of rise in H.Y.V. area. Only 22.95 per cent of the area under *kharif* and *rabi* together has shifted to H.Y.V., and benefits of employment via changes in technology are confined to this fraction of the area and no more than 4 per cent increase in overall employment could be attributed to a shift to H.Y.V.

Will the beneficial effects of shift to H.Y.V. continue in the absence of a rise in intensity of cropping? The answer to the question depends upon the nature of developments in technology. There are eight four-wheeled tractors in the village,

[14] See for details of cost structure based on these surveys [12].

seven of them owned even earlier to 1964–65. Tractor use for threshing and puddling was quite common even on small farms and even earlier to 1965–66. In 1971–72 tractor use for these two operations has become almost universal. Plough cattle are maintained not even by half of the farmers. Tractors are used for transport also. Tractors have affected the number of permanent farm servants, though their adverse effect on casual labor is reported to be only marginal. But one cannot be too sure. Due to absence of a network of effective repair service big farmers continue to maintain plough cattle and rely on labor power. But, when an effective repair service is built up, adverse effects are bound to be felt by labor unless intensity of cropping or shift to labor intensive crops accompanies tractorization. Qualitative data relating to changes in profit from rice cultivation and levels of living confirm that the proportion of households reporting increases in profits from rice cultivation is more among big cultivators as compared to others, among owners as compared to tenants (see Table VIII). The evidence of this village suggests that

TABTE VIII

A. Percentage of Cultivators Reporting Increase by Size

Item	A	B	C	D	E	F	Overall
Profits from rice	20.69	14.29	13.51	36.36	35.00	69.57	32.43
Level of living	13.79	4.76	5.41	27.27	25.00	39.13	18.38

B. Percentage of Cultivators Reporting Increase by Tenure

Item	I	II	III	IV
Profits from rice	36.84	36.36	9.52	62.86
Level of living	15.79	9.09	14.29	34.29

TABLE IX

Distribution of Excess Gross Value per Hectare As a Result of Shift to H. Y. V.

	Kharif		*Rabi*	
	Amount (Rs.)	Percentage	Amount (Rs.)	Percentage
Excess gross value per hectare	768.00		1,274.00	
Due to				
(a) Fertilizer	87.42	11.38	146.09	11.47
(b) Pesticides	24.54	3.20	47.05	3.69
(c) Wages [a]	84.00	10.94	87.00	6.83
(d) Interest on credit [b]	24.00	3.12	10.00	0.78
Subtotal	219.96	28.64	290.14	22.77
(e) Residual due to land ownership and management	548.04	71.36	983.86	77.23

[a] Imputed from the data available with the Agro-Economic Centre, since quantitative data are not available.

[b] Interest is calculated at 10 per cent.

given an unequal distribution of land, the new technology sharpens the inequalities and makes relative distribution of income much worse, since more than 70 per cent of the value added by it per hectare is got by owners of land and wage earners get less than 10 per cent (see Table IX).

IV. SUMMARY AND CONCLUSIONS

Analysis of responses by size and tenure led to the following conclusions:

1. Differences in responses between seasons persist and are more significant than differences by size and tenure. Association between size and adoption of new technology is not found to be significant at levels of below four hectares. No significant association is also observed between adoption and ownership. The lack of association between ownership and adoption gets meaningful in the context of significant changes in the systems of tenure in the post-technology period.

2. The most striking result of the observations is the significant association between size and adoption in both wet and dry seasons when the data are studied by classifying cultivators into groups below four hectares, and those above four hectares implying the stronger response of holdings to new technology by farmers with adequate investable surplus.

3. Inverse relationship between size and productivity found in farm management studies of pre-technology period is not noticed implying that with growing importance of nontraditional inputs the small farmer has lost his traditional advantage. But no firm positive relationship is also noticed.

The study of social and economic impact of new technology revealed the following:

1. There is no evidence of reduced concentration of land. The new technology helped to tighten the grip of the big farmer on rural economy.

2. Lease market, rental market, credit market, and input market do not operate in the interest of poorer sections. Though there is no firm evidence of deterioration in the living standards of small farmer, small tenant, and labor, relative distribution of incomes appears to have worsened.

3. The effect of technology is more on employment than on real wages. But a big farm economy tends to foster capital intensive technology and this might nullify the employment effects. The new technology is not followed by increase in intensity of cropping and therefore beneficial effects of employment are limited.

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APPENDIX TABLE I

DISTRIBUTION OF CULTIVATORS BY SIZE AND TENURE

Kharif Season

	I	II	III	IV	Overall
A	20(1)	1	7	1	29(1)
B	16(1)	—	22(1)	2	40(2)
C	8	2	18	8	36
D	5	—	3(1)	3	11(1)
E	6(1)	2	5(1)	7(1)	20(3)
F	21(7)	6(3)	5(1)	14(4)	46(15)
Total	76(10)	11(3)	60(4)	35(5)	182(22)

Rabi Season

	I	II	III	IV	Overall
A	17(4)	1	5	1(1)	24(5)
B	10(5)	—	19(7)	2(1)	31(13)
C	4	—	11(2)	8(3)	23(5)
D	5(3)	—	3(3)	3(1)	11(7)
E	4	2(1)	5(2)	7(4)	18(7)
F	21(15)	6(5)	5(1)	12(10)	44(31)
Overall	61(27)	9(6)	48(15)	33(20)	151(68)

Note: Figures in parentheses indicate H. Y. V. growers.

APPENDIX TABLE II

DISTRIBUTION OF AREA BY SIZE AND TENURE (IN HECTARES)

Kharif Season

	I	II	III	IV	Overall
A	10.12	0.30	3.84	0.81	15.07
	(0.81)	—	—	—	(0.81)
B	21.96	—	30.86	3.51	56.33
	(0.81)		(1.62)	—	(2.43)
C	19.42	4.05	42.49	19.89	85.85
	—	—	—	—	—
D	17.00	—	10.12	10.04	37.15
	—		(0.81)	—	(0.81)
E	28.85	8.50	23.07	33.65	94.07
	(3.24)	—	(4.05)	(0.81)	(8.09)
F	291.37	90.65	32.78	166.97	581.78
	(40.67)	(11.33)	(6.07)	(6.07)	(64.14)
Overall	388.72	103.50	143.16	234.87	870.25
	(45.53)	(11.33)	(12.55)	(6.88)	(76.28)

Rabi Season

	I	II	III	IV	Overall
A	8.30	0.30	2.23	0.81	11.64
	(2.75)	—	—	(0.40)	(3.16)
B	11.64	—	25.72	3.51	40.87
	(4.53)		(7.79)	(1.59)	(13.91)
C	8.50	—	25.50	14.33	48.33
	—		(3.24)	(4.45)	(7.69)
D	10.32	—	6.88	10.04	27.24
	(5.46)		(5.67)	(3.04)	(14.16)
E	17.12	8.50	21.04	21.51	68.17
	—	(2.42)	(5.26)	(4.45)	(12.14)
F	196.27	71.22	24.28	87.21	378.98
	(103.40)	(54.23)	(6.07)	(40.67)	(204.37)
Overall	252·15	80.02	105.65	137.41	575.23
	(116.14)	(56.65)	(28.03)	(54.60)	(255.42)

Note: Figures in parentheses indicate H.Y.V. area.