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MODERNIZATION OF THE PADDY-RICE SYSTEM AND THE CHALLENGES AHEAD

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Rice is one of the most important cereals grown in India. It occupies about 25 per cent of the cropped area and accounts for about 40 per cent of the total foodgrain production. It is a major source of livelihood for 25 million farm families and 75 per cent of the landless labourers.

The emphasis that the Planning Commission places on increasing rice production is a proof of the importance of rice in the Indian economy. The Fourth Plan states that "the largest single stake in the agricultural programme for the Fourth Plan is provided by the target in rice." It calls for an additional production of 13 million tonnes of rice. This requires an increase in yield to the extent of 340 kgs. per hectare on all rice lands (an increase of 770 kgs. per hectare on irrigated lands) if area under paddy remains at the present level.[1]

An analysis of the trend in the foodgrains production from 1964-65 to 1970-71 reveals that wheat accounted for about 56 per cent of the total increase in cereal production during this period. The trend in wheat production indicates that the total production may stabilize at a certain level and further increases may be possible only at a high cost. The contribution of rice towards the above increase was only about 18 per cent.[2] The rate of growth of other foodgrains was also not very significant. Considering all these factors, it appears that for any substantial increase in food production a breakthrough in rice production is necessary. Past experience indicates that such a breakthrough is possible only through modernization in some elements of the paddy-rice system.

The paddy-rice system has four major components, *viz.*, production, processing, marketing, and consumption. These components are interdependent in various ways and an understanding of their behaviour is necessary to handle the problems of modernization in the system. For example, changes in the production pattern will depend on the evolution of new technology and its transfer, supply of inputs and the adoption of the total package of practices. Some of the inter-relationships in the paddy-rice system can be represented in a flow chart as given in Figure 1.

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1. These estimates are given in the report: An Assessment of Prospects for Increasing Rice Production in India, Ford Foundation, 1971, p. 5. During 1970-71, the production of rice in the country was 42.45 million tonnes with an average yield level of 1,130 kgs./hectare.

2. During the period 1964-65 to 1970-71, wheat production has gone up from 12.29 million tonnes to 23.20 million tonnes (an increase of about 80 per cent), while rice production has gone from 39,03 million tonnes to 42.45 million tonnes (an increase of only about 9 per cent). The total cereal production has increased from 76.56 million tonnes to 96.24 million tonnes (see reference 6).

A Simplified Paddy-Rice System

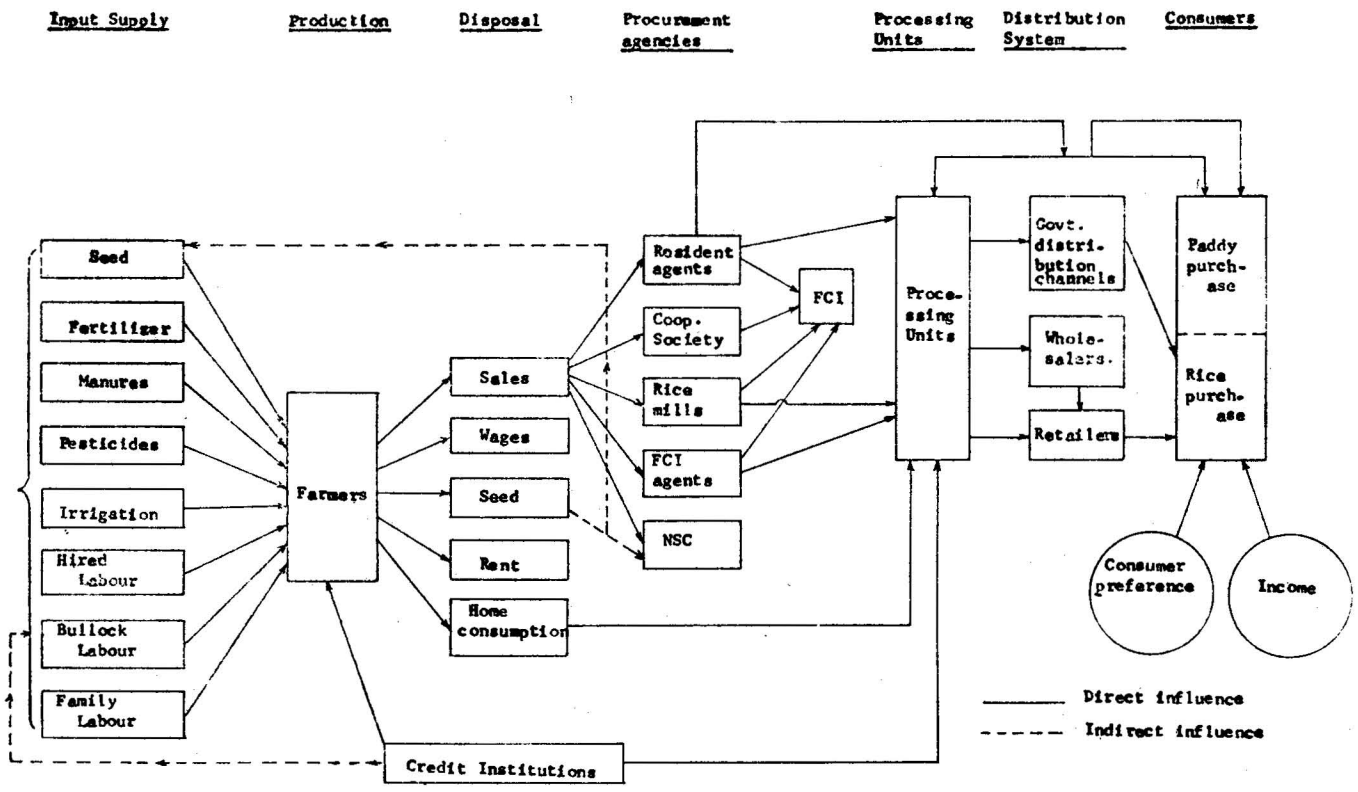

Figure 1

Persons involved in the modernization of the paddy-rice system have experienced various problems. An understanding of these problems which hinder the modernization process is essential for evolving policies for the modernization of the whole system. An attempt is made here to review some of the major problems facing the production, processing, and marketing aspects of the system.

Production Problems

Technological change on the farm is one of the important factors responsible for production enhancement. However, its role is limited by its technological applicability, transfer, and judicious use by the farmers. To facilitate discussion, production problems are grouped into four categories,—application of technology, transfer of technology, supply of inputs and use of inputs.

Application of Technology

Technological developments are often associated with changes in farming practices. To induce the farmers to accept these changes it is necessary that the changes be adjustable to the overall structure of farming operations.

The evolution and introduction of the High-Yielding Varieties (HYV) of paddy was an important technological development in paddy production. However, one of the limitations of the existing HYV paddy is their non-suitability to different agro-climatic environments. For example, Padmanabhan (1970) observes that the farmers in the West Godavari district of Andhra Pradesh need a variety with a longer duration than the present HYV TN-1 or IR-8, so that the harvest period does not fall in the rainy season. Moreover this would also suit the cropping pattern of the region. On the other hand, the farmers of Tanjore district in Tamil Nadu need a short duration variety for the *Kuruvai* season. In the absence of such varieties that satisfy the requirements of the farmers, the extension agencies recommended late/early planting of the existing varieties. However, the attempts to introduce these changes were not very successful, mainly because of the farmers' resistance to these varieties.

The problem of adjustment in the cropping pattern takes another dimension when questions of irrigation and drainage facilities are taken into account. An analysis of the coverage of HYV indicates that the increase in acreage is mainly in areas where adequate irrigation facilities are available. However, considering the fact that less than 25 per cent of the total area under paddy in India has such assured water supply, it is important to note that increases in paddy production cannot be solely dependent upon the varieties suitable to these areas alone.

Further, Herdt (1969), Barker (1970), and others have concluded that the present HYV have a lower yield response to fertilizer during monsoons than during the dry season. However, it has been emphasized that HYV have a higher yield potential than local varieties during both the monsoon and dry seasons.

The problem of evolving varieties suitable to local conditions is further complicated by the diversity of soil and water management conditions in the same region and between different regions. For example in the West Godavari district while the eastern delta has perennial irrigation, good soil, and good drainage facilities, the western zone is subject to floods during the monsoon. The eastern region is therefore, highly productive, but the western region often poses problems of water management. Thus, even though the two zones of the district are geographically close together, it is necessary that the varieties of paddy and the cultural practices recommended for these two zones be different.

These evolved varieties pose some more problems. A major weakness of the HYV is that they are very susceptible to diseases and pests. This is especially so in the coastal districts which have a high level of humidity. This low resistance implies that growing the HYV involves a higher risk.[3] Even in some of the interior areas, it was this low resistance which was mainly responsible for its poor performance.[4]

Another important factor influencing the continued adoption of the improved varieties is their cooking quality. If a variety adopted for cultivation in a region has to survive on a commercial basis, it is necessary that the consumers of the variety be satisfied with the qualities of the grain. A study conducted in the West Godavari district indicated that the farmers preferred to consume local varieties. The whole family's consumption requirements were met from the local varieties grown during the *kharif* (rainy) season. The HYV were mostly grown as a second crop and were mainly sold.[5] This factor, together with the risk involved in the cultivation of improved varieties has been responsible for the reduction in area under HYV during *kharif* in the West Godavari district.

The net return to the farmers is dependent on the varieties grown and the application of proper levels of inputs at the right time. To obtain the desired results from paddy cultivation, a proper package of farming practices should

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3. This aspect has been highlighted in a number of studies. For example, see, Ford Foundation: An Assessment of Prospects for Increasing Rice Production in India, 1971.

4. A study on the acceptance of IR-8 in the Karnal district of Haryana State has particularly pointed out that this is one of the factors responsible for the poor performance of this HYV. See Agricultural Economic Centre, Delhi, 1968.

5. See P. S. George and V. V. Choukidar: Production and Marketing Pattern of Paddy, Centre for Management in Agriculture, Indian Institute of Management, Ahmedabad, 1972.

be followed.[6] However, the present level of technology is such that the recommended package of practices may not be optimal. The acceptance of the total package will also be dependent on the quality of the package itself.

Transfer of Technology

Existence of varieties suitable to the agro-climatic conditions of a region and the tastes of the consumers is only one of the necessary conditions to improve paddy production. The success of a new technology also depends upon the efficiency in transferring the technology to the farmers. However, it is difficult to transfer complex technologies to the farmers and get them accepted in a short period of time. Problems of diffusion and effective communication make acceptance difficult. Moreover, the current level of adoption depends to a large extent on the previous level of adoption, the speed at which this adoption takes place, and the experience of the previous adopters.

A number of studies in the area of diffusion of agricultural technology conclude that no single medium can be uniformly effective in diffusing agricultural technologies to farmers with varying geographical and socio-economic conditions. Mass media which have the greatest potential for speedy diffusion, also pose various problems due to differential cultural perceptions and other socio-cultural factors. Although, group contacts and personal contacts are reported to be effective means of communication, their use is restricted on account of the non-availability of technical man power and the improper understanding of the process of communication. Result demonstration which is rated very high among communication methods is not properly understood and hence, its effectiveness is reduced to a considerable extent.[7] Individual contacts with the farmers are not always feasible because the task involved is enormous. Even in IADP areas where Village Level Workers (VLW) are employed to prepare and execute farm plans, the progress is slow on account of a number of limitations.[8]

The diffusion of technology should also be associated with an effective process of communication. In many circumstances, the factors inhibiting diffusion may not necessarily be the constraints on communication. The effectiveness of a communication process is largely dependent upon its components, *i.e.*, sources, message, channel treatment, audience, and response.[9]

6. Here again, the magnitude of the problem will vary according to a number of factors like soil conditions and irrigation facilities available. For example, the package for growing paddy in saline soils will be completely different from other types of soil. Recent studies have evolved certain practices like surface flushing for minimization of soil salinity and avoiding the loss of nitrogenous fertilizers by way of proper placement, use of nitrification retarders and slow releasing fertilizers. See K. N. Singh (1970) and Rajendraprasad (1970). However it is not clear as to whether these practices would ensure the optimum returns to the producers.

7. Singh and Kumar (1965) give a fairly detailed description on the purpose, process, and technique of result demonstration.

8. P. R. R. Sinha (1965) points out some of these limitations, *i.e.*, large number of plans to be prepared in a short period of time, lack of conviction in the package itself, and poor understanding on the part of the farmers.

9. A description of the communication process is provided by Leagons (1960).

In the past, a large number of studies were conducted to identify the factors responsible for increasing the effectiveness of communication.[10] In the light of these studies, the present extension efforts need to be improved so that the innovations are adopted by the farmers.

Supply of Inputs

The success in obtaining increased paddy production through improved varieties will partly depend upon the level of inputs used. Improved technology makes it possible to achieve higher yield rates through a shift in the production function, and this shift can be achieved by using higher doses of inputs as compared with the level used for traditional varieties. The rate of inputs used for paddy will be related to many factors, including the extent of supply of inputs and the adoption pattern of the farmers.

The problems associated with the supply of adequate quantities of inputs can be classified into two broad categories—those related to the level of production of inputs and those related to the marketing of inputs.

A few studies on the implementation of the high-yielding varieties programme for paddy have shown that in spite of planning the programme effectively, it could not be implemented properly, mainly, because of the non-availability of inputs as and when the farmers required them.[11] The major factor considered to be responsible for the non-availability of the inputs in time was the delay in the administrative machinery of the State and Central Government. In some cases, even when the input was available, it was not properly distributed among the farmers.

Khusro (1969) in his Presidential Address at the conference of the Indian Society of Agricultural Economics, pointed out that

> "the agricultural transformation is much more in evidence in the quantity and quality of inputs used than in the change in the output or change in cropping pattern. The demand curve for inputs seems to have shifted markedly rightwards and upwards. Nitrogen use grew at 14 per cent and nitrogen plus phosphate at 17 per cent per annum during the 1950s, but during the 1960s these rates jumped up to 24 per cent and 27 per cent per annum. The use of improved seed in the IADP districts grew at no less than 40 per cent per annum in the 1960s. Moreover, it must be remembered that owing to the supply shortages that have developed in the 1960s, the farmer's demand has not had a full and free expression in the market, or else the figure of input use might have shifted upwards even more sharply than they have."[12]

10. A summary of these studies is available in Jha's unpublished Ph. D. thesis (1970).
11. For example, See M. M. Malya and P. P. Madappa: High Yielding Variety Paddy in Tanjore District, 1967.
12. A. M. Khusro, "Agricultural Revolution and Price Mechanism," *Indian Journal of Agricultural Economics*, Vol. XXIV, No. 1, January-March, 1969, p.2.

He further added that due to the unrealistic estimate of demand, the input production targets were absurd. However, this situation has improved since 1970. It is expected that the setting up of few fertilizer units and the expansion of existing units will make it possible to achieve self-sufficiency in commercial fertilizers by 1976.

Use of Inputs

To obtain the most profitable level of output from the new paddy varieties it is necessary that the inputs are used in certain combinations and some of the cultural practices are followed in a specific order. Agronomic researches in many parts of the country have shown that maximum benefits would accrue to the farmers if the package of practices was followed completely.

The Programme Evaluation Organisation of the Planning Commission, after studying the pattern of adoption of the package of practices in relation to four important practices, *i.e.*, seed treatment, application of fertilizers, plant protection measures, and inter-cultural operations concluded that the manner of this adoption was not encouraging.[13] Similar results were obtained in a study conducted by Rao (1967) and the authors (1972) of this paper. In many areas, the package of recommended practices was not fully adopted and in some other areas there were cases of over adoption. Non-adoption of the recommended package of practices was partly due to economic reasons like small farm size, difficulties in mechanization, and problems of water management and partly on account of socio-psychological factors like the knowledge and attitude of the farmers.

The data on agricultural production pattern indicates that paddy is usually grown on small farms. Though the farm size is fairly low for the country as a whole, it is still lower in the paddy growing States of West Bengal, Orissa, Tamil Nadu, Andhra Pradesh and Kerala. Some studies show that the pace of modernization in agriculture has suffered on account of the small size of holdings. However, in some areas the farm size does not seem to be a hindrance to agricultural development.[14]

Similarly, multiple cropping which is an important step in the modernization of paddy production was not followed due to problems like small farm size, growing labour force, and water logging conditions which hinder increased mechanization. The inability of the existing irrigation system to respond quickly to changes in the command or service areas has often posed problems in adopting improved water management practices. For example it was pointed out in the Ford Foundation Study that changes in the volume level of water at the Mettur dam were reflected in the canal irrigation system

13. Programme Evaluaton Organisation: Evaluation Study of the HYV Programme, Report for the *Rabi* 1968-69, Wheat, Paddy and Jowar, Planning Commission, Government of India, 1969.

14. This aspect is discussed by Carl C. Malone (1970) while analysing the progress in modernization of the paddy-rice system and some other crops in the IADP districts.

of the Tanjavur paddy fields only after seven days. Such delays together with an individual paddy grower's lack of control over drainage facilities have affected the adoption of water management practices in paddy production.

Problems of Processing

India has about 50,000 rice mills of which about 87 per cent are hullers, 5 per cent are shellers, and the rest are a combination of the two.[15] It is estimated that on account of the traditional milling system, the country loses about 1.52 million tonnes of rice valued at Rs. 1520 million each year. Problems of obtaining good quality rice bran also exist. In many areas, there is no proper recovery of rice bran obtained through milling. The quality of the bran recovered may not be good enough for extraction of edible oil or for use as cattle feed. One estimate indicates that each year the loss in this manner may be about 8 to 9 lakh tonnes of edible oil valued at Rs. 2550 million.[16]

Processing losses could be minimized either by modernizing the existing sheller type rice mills or by introducing modern rice mills. However, both these approaches have certain problems. Modernization of an existing one tonne sheller type rice mill requires an additional investment of about Rs. 50,000. As there are a large number of such mills needing modernization a huge capital investment will be required.

Apart from modernization of the milling facility, it is also possible to introduce economies by modernizing storage and drying facilities. While assessing the economic implications of modernization in terms of drying, storage, and milling, Desai (1970) indicates that while the introduction of drying and milling equipment is feasible, the introduction of silo storage with an existing capacity of 7,200 tonnes is not profitable. Thus, modernization of the existing rice mills is handicapped by the fact that modern storage methods are not available at low cost levels.

The alternative method of introducing modern mills also has serious limitations. The operations of these modern mills will be economically viable only after the mills achieve a certain minimum level of capacity utilization. In fact, this break-even volume level is so high that many mills are not in a position to procure the quantities required to achieve this level. A mid-term appraisal of the functioning of some of the modern rice mills from January, 1970 to July, 1970 indicated that during all these months the mills could never run at their full capacity.[17] A lot of time was also wasted on account of breakdown of machinery and subsequent repair work.

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15. These figures are provided by Agarwal (1969).
16. V. K. Gupta, "Modernization of Rice Mills," *Bulletin of Grain Technology*, Vol. VIII, No. 4, December, 1970.
17. This has been pointed out in an official note on the working of the modern rice mill at T.P. Gupem in West Godavari.

Lack of capital, non-availability of sufficient quantities of paddy, and unfavourable government policies have often disrupted the working of modern rice mills. The loss in efficiency in large scale mills resulting from higher assembly cost may sometimes turn out to be a strong case against the existence of a large size modern mill. It is also worth considering the social inefficiency of substituting capital intensive milling and warehousing facilities for more labour-intensive milling facilities in the Indian economy where unemployment is a big problem and labour is relatively cheap.[18]

Problems of Marketing

The efforts on production enhancement were not often accompanied by efforts of market development. Though the efforts made to popularise HYV did result in increased production of paddy in many areas, sufficient attention was not given to providing the farmer with adequate facilities for marketing the grain produced. There were instances where farmers could not sell all the paddy produced by them at a reasonable price. In some areas, government agencies like the Food Corporation of India have stepped in to procure paddy from the farmers. In spite of these activities, the farmers realised low prices for the HYV paddy. The financial position of many small farmers was such that they could not retain paddy for a long period after the harvest. Therefore, they were forced to dispose it off at the price that existed during the harvest period. Storage facilities were often inadequate. This might have influenced some of the government procurement agencies not to buy all the paddy available in the market at the support price. Many factors have contributed towards reducing marketing efficiency and thereby, lowering the profitability of increased paddy production.

Problems of Consumption

It was pointed out earlier that the success of the HYV programme depends to a large extent on the acceptance of these varieties for consumption purposes. The study by Apodaca (1952) on the adoption of hybrid corn indicates that the farmers reverted to old varieties on account of the colour of Tortilla prepared out of hybrid corn. Similar observations could be made in the case of paddy where a number of characteristics related to the cooking qualities of the HYV have influenced the farmers not to grow them.[19] A study conducted at the Indian Institute of Management, Ahmedabad indicated that in a sample of 80, the lack of desired cooking qualities influenced 78 paddy producers to decide against the use of HYV for consumption. A sample of 100 consumers buying paddy from the local markets around a major

18. This issue has been raised in a number of professional meetings. For example, at the Rice Policy Conference held at the International Rice Research Institute, Los Bonos, Philippines during May 9-14, 1971 this issue was raised by a number of economists.

19. The case of the West Godavari farmers is an example for this. The farmers preferred to consume local varieties of paddy over the HYV. Therefore, many of these farmers cultivated local varieties during both crop seasons. Those who adopted HYV for the second crop had retained enough local varieties of paddy from the first crop for their home consumption.

paddy producing area and another sample of 120 families buying rice from two major cities in the same State were studied and it was found that they used very little quantities of HYV paddy.[20]

In the past, since rice production in a number of States was very much less than the consumption requirements, the HYV not in demand in the producing States were shipped to the deficit areas and therefore the problem of disposal was not very acute. However, when paddy production in these deficit areas also increases, then the HYV which lack proper cooking characteristics will find it difficult to obtain proper market outlets. The consequence of such a situation will be a low price for HYV which will lead to the non-adoption of the varieties. Here it may be pointed out that this observation is based on the characteristics of IR-8 as perceived by the consumers in Andhra Pradesh. Some of the newly evolved varieties like *padma*, *pankaj*, and *jagannath* are considered to have the characteristics of the locally preferred varieties. However, since these varieties are not widely available in the market, it is too early to test whether the consumers' perception of these varieties coincide with the expectations of scientists evolving these new varieties.

The unfavourable attitude of consumers towards the HYV is mainly due to factors like taste, polish at the time of milling and quantities required for cooking. To induce the consumers to adopt HYV, it is necessary that the improved varieties suit their requirements specially with regard to the above mentioned factors. They should meet the expectations of both the producers and consumers.

Conclusion

The foregoing analysis leads us to conclude that the success of the attempts at modernization will largely depend upon the following aspects:

1. Evolution of varieties suited to the agro-climatic condition of the paddy growing areas and having consumer acceptance.
2. Development of suitable package of practices for the evolved varieties.
3. Identification of effective means of diffusion of new technologies and communication strategies for getting the paddy producers to accept the new technologies, and the recommended package of practices.
4. Streamlining the production and distribution of agricultural inputs such as fertilizers and pesticides.
5. Modernization of rice milling facilities either through the introduction of modern mills or through modernizing the existing mills.
6. Provision of proper marketing facilities to the paddy producers.

20. Details regarding the paddy consumption pattern of households from local markets and two urban areas are available from a study being currently undertaken in the Centre for Management in Agriculture at Indian Institute of Management, Ahmedabad.

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