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INNOVATION AND ENTREPRENEURIAL DECISION IN INDIAN PADDY ENTERPRISE[1]

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Innovation represents the application of knowledge or technique, hitherto unused, to any type of production process. The knowledge involved need not be a recent invention, although it is often of this nature. Thus, the existing stock of knowledge is clearly a determinant, although not necessarily the most important one, of innovation. For example, change in state of knowledge may enable a producer to produce a commodity by combining resources in a new way or to produce a new commodity. In other words, accretions to the knowledge stock enlarge the range of alternatives in production. Out of this enlarged set of production alternatives there may be one (or more) given product and factor prices that implies the possibility of a profitable new venture.

Since the golden era of "Industrial Revolution", there has been a strong emphasis on the role of entrepreneurs in the adoption of advanced technology. One of the prominent authors who put strong emphasis on the role of entrepreneurs in the phase of economic development was Schumpeter.[2] He argued that creative innovations are the functions of free entrepreneurial activity requiring the knowledge and skills of the entrepreneur. An increase in the stock of knowledge changes the environment in which the entrepreneur decides whether or not to engage in a given activity. Investigating the strategy of technological change, Mrs. Robinson[3] says that in a dynamic system there are entrepreneurs who are continually introducing improvements in methods of production. Some firms are the first to make innovations, while the rest follow only when compelled to do so by the pressure of competition. The speed at which new methods are diffused throughout the economy depends partly upon the nature of resources available in the economy.

However, the objective of this paper is to present the case of entrepreneurial decision with technological change in Indian paddy enterprise. In general, it is assumed that there are two situations for entrepreneurial decision. In one situation, economic decision is very limited in scope due to absence of alternatives in resource allocation. In the second situation, other enterprises compete with, supplement or complement the paddy enterprise. Under this situation, economic decision plays the most active role. The decision is directly related to the profit and loss of the enterprise and is affected by market uncertainty and technological uncertainty.

Assuming a given market condition, the entrepreneurial decision before the paddy growers is how to reorganize the allocable resources so that the paddy enterprise would attain maximum net return. With given knowledge of new

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2. Schumpeter, J. A.: The Theory of Economic Development, Harvard University Press, Cambridge, 1944.

3. Robinson, J.: "The Classification of Inventions", *Review of Economic Studies*, Vol. 5, February, 1938, pp. 139-143.

resource, the paddy growers are faced with the economic decision of resource substitution. Keeping in view the entrepreneurial decision, let us see the technical relationships of paddy production before technological change and after technological change.

(A) $Y_1 = F_1 (X_1, X_2, X_3)$

Y_1 = paddy product (in maunds)

X_1 = acres of land

X_2 = man hours of labour

X_3 = rupees spent on variable inputs (*e.g.*, seeds)

Under the theoretical framework of reference, we assume the production function to be continuous with the condition of diminishing marginal physical productivities of above resource inputs. The marginal physical productivities of inputs X_1, X_2 and X_3 are given as follows:

(A) (1), (2), and (3),

$$\frac{\triangle Y_1}{\triangle X_1}, \frac{\triangle Y_1}{\triangle X_2}, \text{and } \frac{\triangle Y_1}{\triangle X_3}, \text{ respectively.}$$

To maximize for each selected resource input, the returns above its (variable) costs require:

$$\left(\frac{\triangle Y_1}{\triangle X_1}\right) P - C_1 = \left(\frac{\triangle Y_1}{\triangle X_2}\right) P - C_2 = \left(\frac{\triangle Y_1}{\triangle X_3}\right) P - C_3,$$

Where C = cost of input, P = price of product.

We now turn to the situation of technological change consisting of commercial fertilizer, for which pounds per acre are given by X^1_3. Under this situation, technical relationship can be written as follows:

$$(B)\ Y^1_1 = F_2 (X_1, X_2, X_3, X^1_3)$$

We again assume (in B) that the production function is continuous with diminishing marginal physical productivities given by,

(B) (1), (2), (3), and (4)

$$\frac{\triangle Y^1_1}{\triangle X_1}, \frac{\triangle Y^1_1}{\triangle X_2}, \frac{\triangle Y^1_1}{\triangle X_3}, \text{ and } \frac{\triangle Y^1_1}{\triangle X^1_3}, \text{ respectively.}$$

With two above written technical relationships (A) and (B), one can see the properties involved with them. Here we suppose that (A) and (B) are identical in coefficients of X_1, X_2, and X_3; yet for given inputs in these categories Y_1 in (B) exceeds Y_1 in (A) by,

$$N = \frac{\triangle Y_1}{\triangle X^1_3} \cdot X^1_3$$

As marginal physical productivities of input are unchanged, the increase N, in output of paddy crop may be accounted for by the new input X^1_3. This category of technological change is pointed out by Solow[4] in an article where he describes as "neutral" such changes as will leave unchanged the marginal rates of substitution between resource inputs.

Since we assume the conditions of a competitive market for the sale of outputs and purchase of inputs, we can write the profit equation ascribing the whole value of marginal product for X^1_3 in (B) to technological change. Thus,

$$\frac{\triangle Y^1_1}{\triangle X^1_3} = \frac{C_3}{P_1} \; ; \; i.e., \; \triangle Y^1_1 \cdot P_1 = \triangle X^1_3 \cdot C_3.$$

Then, we may suppose that the introduction of X^1_3, besides increasing the output of paddy crop per acre, changes the marginal physical productivities of one or more inputs. We can cite the example of increase in marginal physical productivity of land as follows:

$$\frac{\triangle Y^1_1}{\triangle X_1} > \frac{\triangle Y_1}{\triangle X_1} .$$

Under this new assumption, fertilizer innovation changes the production function. It not only brings increase in the net output of paddy crop, but it also implies that the reduced marginal cost of using X_1 for Y_1 arrests the decreased productivities of other inputs by at least enough to pay for the use of X^1_3. We find this category of technological change in Lange and Joan Robinson's classification of technological change.

However, the course of action of paddy growers depends on the effect of an innovation decision on expected marginal cost of output of paddy crop per acre in a given crop year as well as expected marginal cost of output of paddy crop per acre planned for some future date. The same applies to the marginal physical productivity of factors used in period *t* and expected in some future date. Paddy growers' response may be more favourable if innovation increases the marginal physical productivity of factors used in period *t* and decrease marginal cost of output. Nevertheless, with the limited allocable resources between two alternative enterprises, *e.g.*, paddy and sugar beet, paddy growers might face a critical decision situation. It will be more convenient for them to use the market price received for the two products between which there is competition for resource use. (Consider Y_1 as paddy crop, Y_2 as sugar beet crop.) In an equilibrium situation, resources are allocated between two enterprises so that the marginal rate at which the output of product Y_2 substitutes the output of product Y_1, equals the ratio price of Y_1 to price of Y_2. The equilibrium situation will give maximum returns above the cost of the allocable resources. This can be expressed in the following way,

$$\frac{\triangle Y_1}{\triangle Y_2} = \frac{P_2}{P_1} \; ; \; i.e., \; \triangle Y_1 \cdot P_1 = \triangle Y_2 \cdot P_2.$$

4. Solow, R. M.: "Technical Change and the Aggregate Production Function", *The Review of Economics and Statistics*, pp. 61-69. February, 1956.

Most economic decisions entail risk and uncertainty. Those of Indian paddy growers are no exception. Indian paddy growers may even be more vulnerable due to their limited economic horizon. The limited economic horizon implies a high rate of discount attached to opportunities with future pay off and the small (if any) surplus above living requirements create for the cultivator a deterrent to changes that entail uncertainty. With limited available capital, paddy cultivators face critical decisions in terms of making investments either in paddy or in other crops depending upon the expected net differential return from the two alternatives; or the revenue earned in one crop might be invested in other crops to maximize total farm income.

Individual decision in risk and uncertainty situation reflects the nature of human behaviour. In a true sense, human behaviour is learned. To understand thoroughly any item of human behaviour—either in the social group or in the individual life—one must know the psychological principles involved in its learning and the social and economic conditions under which this learning took place. In its simplest form, learning theory is the study of the circumstances under which a response and a cue stimulus become connected.[5] Response takes place according to the reward paid to the learner. There may be different kinds of reward. But since here response is in context of profit motive behaviour, reward should be understood as economic rewards. However, the joint operation of psychological principles and social conditions lead to imitation. Imitation is a process by which "matched," or similar, acts are evoked in two people and connected to appropriate cues.[6] It can occur only under conditions which are favourable to learning these acts. The social attitude toward imitation is often a decisive variable in determining whether or not individual response shall take place. There seem to be cases where the individual groups have been sufficiently rewarded for imitating in the past so that they adopt a permissive attitude toward innovation. On the other hand, bad experience with former imitation will tend to limit further imitative behaviour. This applies very well to the economic decision of the entrepreneurs in imitating some new practices in a farm enterprise. Their past experience of profit and loss in imitating the new practices becomes the guiding force in determining their future step of imitating the new practices. But imitative behaviour implies other conditions too. What appears to be an advanced technology may not be imitated by some entrepreneur because of differences in relative scarcities of resources available to different entrepreneurs and differences in the relative advantages of two enterprises where there might be competition for the use of resources.

The amount and character of the capital supply plays a significant role in shaping the rate and direction of technological change. Since many apparently advanced techniques are capital intensive, a growing supply of capital will not only increase the rate of change but will also lead to continued movement toward more advanced methods.

However, the course of action which is or should be followed by the decision maker in the paddy enterprise is conditioned not only by the nature of his expec-

5. Miller, N. E.: Social Learning and Imitation, Yale University Press, New Haven, 1941, p. 1.
6. *Ibid.*, p. 10.

tations but also by the surrounding (or local) decision making framework. Two paddy growers with identical expectations and viewing the future with similar degrees of uncertainty may rationally follow different courses of action because the framework within which decisions are made differs. The farmer with small capital may justifiably use his resources differently from the operator owning many assets. The pure manager who does not accept the full consequences of outcome may select a different course of action than the owner manager. Thus, given an uncertainty and risk setting, the optimum plan for any individual decision maker depends on his psychological make up, his institutional background, his source of capital supply, his technical know-how, and the ends to be maximized. The ends to be maximized vary quite a bit in decision making depending upon the economic interaction between the firm and the household. In a situation as it prevails in India, economic decision is very much guided by the intensity of this interaction.