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# **IMPACT OF MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE PROGRAMME (MGNREGP) ON THE RURAL POOR- A SIMPLE THEORETICAL DISCOURSE**

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## **Abstract**

The basic objective of the Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGP) is to provide safety net for the rural poor and to stabilize agricultural production through creating productive assets via employing labourers. Two important linked aspects are worth noting in respect of implementation of the programme. Implementation of MGNREGP in multiple cropping areas can increase the employment opportunities among the landless agricultural labourers and thus has inevitably raised their bargaining power particularly during the time of second crop i.e. post rainy season cultivation. Besides this, Government of India has persistently been hiking per man-day MGNREGP wage. Both these instances undoubtedly increase the reservation wage in agricultural labour market which in turn may have an adverse effect on the farm income in the multicropping areas. In this paper, maximum possible per man-day MGNREGP wage is determined at which the corresponding agricultural wage can help the marginal farmers to sustain their net farm income at least at subsistence level. This paper also establishes the fact that as a result of the hike of MGNREGP wage, sustenance of subsistence net farm income may lead to price hike in agricultural sector. The study also attempts to analyze the results in respect of aggregate net pecuniary benefits of the rural poor in the light of MGNREGP considering different agricultural frameworks.

Key words: National Rural Employment Guarantee Programme, Agricultural Labour Market, Net farm income, Aggregate net benefit, Material cost

*JEL Classifications: J43, O38, Q12*

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# **IMPACT OF MAHATMA GANDHI NATIONAL RURAL EMPLOYMENT GUARANTEE PROGRAMME (MGNREGP) ON THE RURAL POOR- A SIMPLE THEORETICAL DISCOURSE**

## **I. Introduction:**

Government of India has initiated National Rural Employment Guarantee Programme which is presently known as Mahatma Gandhi National Rural Employment Guarantee Programme (MGNREGP) where the basic objective is to provide 100 full man-days of employment to each willing rural household. It is expected that MGNREGP can generate income support for the poor and can raise agricultural productivity as well as profitability in the long run through creating different productive assets related to agriculture. As for example, the Employment Guarantee Programme (EGP) in Maharashtra was able to avert famine during draught of 1970-73 and reduced poverty while Rural Public Works Programme in Bangladesh has been commented to its contribution to rural development and increased agricultural productivity through the creation and maintenance of rural infrastructure (Dreze and Sen, 1991). Employment generation through MGNREGP emphasized its role in income insurance in the presence of seasonality in agricultural labour market (Basu, 2011). Dev (1995) reported that Maharashtra EGP and agricultural employment were complementary in the sense that EGP employment was high in lean season (April-July) and low in peak season (October – January). He had shown that in two villages within Maharashtra, negative correlation was observed between the EGP employment and agricultural employment where the values were -0.68 and -0.33 respectively. On the basis of this he concluded that MGNREGP should not compete with agricultural labour hiring decision. Besides that this programme will generate productive assets which can directly influence agricultural productivity as well as profitability in the long run. The ‘productive assets’ include water harvesting, construction of irrigation canals, land development, flood control to reduce vulnerability of rural people and improvement of rural connectivity.

Initially the contemplation was that the employment be provided mainly in the agricultural slack season when the rural poor especially the landless labourers are absolutely jobless. But to reach the target and for proper utilization of funds, the local panchayats sometimes offer job under MGNREGP even in the agriculturally busy season in the multiple cropping framework mainly

during the time of cultivation after rainy season. Then, the agricultural labour households have two choices: either the labourer can work as an agricultural labourer or he can work under MGNREGP. The small as well as marginal farmers<sup>1</sup> also have two choices. He can start agricultural production for second crop with the help of hired and family labourers or he can engage himself and his family members to work under MGNREGP on the basis of assumption that all the working members of the marginal farm households are job card holders. This actually increases the bargaining power of the local labourers and the land holders of farmer households need to raise wage of the workers during the time of hiring in order to get ready availability of labour. Basu *et.al.* (2009) developed a theoretical model to analyze different implications of such public policy in the context of labour market. According to them such programme introduces ‘contestability’ in the agricultural labour market where government and the land-lord class are two different employers. They had shown that the outcome with respect to wages and overall level of employment in the labour market depends on the degree of distributional concern of the planners. In effect, implementation of MGNREGP raises the reservation wage of the agricultural labourers in an imperfectly competitive rural labour market which may reduce private employment in standard framework.

The government can influence the MGNREGP piece rate in two ways (i) it can enhance the wage rate keeping the task unchanged or (ii) can reduce the task at unchanged wage rate. In this theoretical framework both the possibilities will be considered.

According to the recommendation of the expert committee set up by the Union Rural Development Ministry, piece rate of MGNREGP should be the minimum wage fixed by the respective state. The panel also recommended linking of the per man-day piece rate to the consumer price index of rural labourers for protecting MGNREGA piece rate against inflation. But hike of farm wage is observed after the hike of MGNREGP piece rate. Report of the Commission on Agricultural Costs and Prices (2012), Government of India has argued that MGNREGP has been one of the factors that has contributed to increase in agricultural wages. The report mentioned that the trend in real wage of the farm labourers irrespective of gender increased at a slower pace between 2000-2004, but thereafter the real farm wage has increased

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<sup>1</sup> Farmers who own up to 1 hecter of land are called marginal farmers and farmers who own up to 1-2 hecter land are called small farmers.

significantly which coincides the phase of MGNREGP implementation. Haque (2013) comments that the MGNREGP has resulted in substantial increase in the market wage rates of agricultural and non agricultural labourers and also makes a note that the fact is confirmed by the NSSO 66<sup>th</sup> Round. Reddy (2013) reports that the introduction of MGNREGP with minimum and equal wages for male and female workers, did bring about not only an increase in the overall agricultural wages but also reduction in the male-female wage differentials. According to him, wage increases were reported in a number of states like Punjab, Haryana, Gujarat and West Bengal etc. and higher wages in MGNREGP has diverted workers from agriculture and has created labour shortages in agriculture.

In this situation, incorporating the stylized facts in a theoretical model we try to find the maximum permissible hike of MGNREGP wage which can sustain the minimum net farm income of the small and marginal farmers from secondary agricultural production activities. The basic objective of this paper is to investigate the impact of the hike of MGNREGP wage on net farm income and employment generation in agricultural labour market. This is dealt with in section II where as section III investigates the status of aggregate net benefit as envisaged in different agricultural contexts. It also focuses on the responsiveness of aggregate net benefit with respect to relevant policy parameters. Section IV concludes.

## **Section II. The General Framework of the Model:**

There is no uncertainty in this model and it is assumed that all the farm households are marginal farmer households. We here consider two types of economic agent in the village economy: (i) the marginal farmers who cultivate their own land with the help of family labour force and hired labourers and (ii) the landless agricultural labourers. We also assume that all the adult members of representative marginal farmer households are job card holders and only the agricultural labourer holds the job card.

Consider a marginal farmer household<sup>2</sup> who cultivates his own land with the help of family labour force denoted as  $L_F$  and hired agricultural labourers denoted as  $L_H$ .

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<sup>2</sup> In terms of numbers, India at present has about 82 million landless labourer and 80 million small and marginal farmers who also have to work as an agricultural labourer (Ministry of

It is assumed that two kinds of labourers are replaceable by one another as regards the nature of job to be done<sup>3</sup>

The normal working hour of each labourer is 1 and each family labourer has to work more than the normal working hour and the extra hour is denoted as ‘ $H$ ’. Here  $H \in (0, \overline{H})$  where  $\overline{H}$  indicates maximum hours a family labourer can work more than the normal working hour. So total labour hour used in the production process of a single household will be  $\{L_F(1+H) + L_H\}$ . Now if ‘ $E$ ’ be the effort level<sup>4</sup> devoted by each labourer in each hour then the agricultural production function for each farmer will be<sup>5</sup>

$$Y = A\{L_F(1+H) + L_H\}^\alpha E^\alpha \dots\dots\dots(1) \text{ where } \alpha \in (0,1).$$

Here we hypothesize that the representative marginal farmer household sells her entire crop and ‘ $P$ ’ is the price per unit of the produced crop. Again ‘ $A$ ’ is a parameter standing for inputs other than labour and irrigation, such as capital goods required during the time of agricultural production, viz- hand tractor, fertilizers etc. Since we consider only marginal farmers and moreover they are considered as homogeneous, so the size of land and capital used can be considered same across different farming households. This implies that the cost of capital can be cross-sectionally taken as given. In this model we consider a developed agricultural framework with no suspension of work under MGNREGP except the rainy busiest season because during that time it is strictly guided that no MGNREGP project can be undertaken. So a labourer has to choose between doing job under MGNREGP or doing job as an agricultural labourer except that time period.

Agriculture 2000-01). In this model, we shall concentrate on the impact on net farm income only on marginal farmer households after gradual hike of MGNREGP wage.

<sup>3</sup> In the model the rural poor consists of two sections- marginal farmers and landless labourers. Again in the absence of joint family system it has become hard to carry out agricultural activities only with the help of family labourers. Thus both kinds of labourers (family and hired) are needed. But they are identical in terms of the task they perform.

<sup>4</sup> Here effort level ( $E$ ) implies the effective physical and mental involvement a standard nourished worker devotes in each hour and is considered exogenous in the model. Thus with respect to a specific kind of work,  $E$  can be thought of as an impersonal attribute which remains invariant from person to person.

<sup>5</sup> Like Neo classical type production function, labour measured in terms of hour is the only factor which influences the agricultural output. For the simplicity of this model, we assume that total man-day used in the production function is ‘1’.

For the simplicity of the model we rule out the possibility of the availability of non-farm employment among the rural casual labourers in that locality.

The entire theory is concerned with the agricultural production during the time of cultivation of the second crop which happens only after the completion of principle crop production conducted in the rainy season when no MGNREGP project can be undertaken. Thus our model presumes that choice between two options will arise during the time of second crop production in agriculturally developed region. Therefore the so called contestability arises only after the completion of rainy season.

We have already mentioned that Government of India in last eight years has been gradually increasing the MGNREGP piece rate of each labourer for each man-day work. This MGNREGP piece rate most of the times seems attractive relative to non MGNREGP market wage and therefore bring the risk of upward wage pressure. So in the presence of MGNREGP, the landlord cum employers who have to depend on hired labour for cultivation need to raise wage of the workers they hire in order to ensure the necessary supply of labour. If  $W_M$  is per man-day wage a labourer can earn through MGNREGP, then to get them employed the farmer offers  $\beta W_M$  to each hired labourer where it is implied that  $\beta \geq 1$  which means each hired labourer is offered at least the MGNREGP wage otherwise it is not possible for him to avail their labour supply<sup>6</sup>. Now we want to locate the maximum possible wage rate Government should offer under MGNREGP for one-man day work which leads the marginal farmers to continue their agricultural production rather than to stop it and entirely switch over to MGNREGP.

Due to working in own family farm each family labourer sacrifices his (her) job under MGNREGP from which he can earn  $W_M$ . Apart from that they also devote extra hour over and above the normal working hour in the production process. In effect, their net farm income in agricultural production for second crop hinges on two factors. On the one hand, it depends upon the number of hired labourers and on the other hand, it depends upon the extra hour that the farmer has to devote to keep the agricultural production going. Thus if  $L_H$  is varied, then it will

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<sup>6</sup> It is told that expansion of MGNREGP has boosted wage rate of agriculture by 5.3% on an average between 2010 and 2011. A study by T. Haque (2013) also reveals that in the district Dindigul of Tamil Nadu an increase in the agricultural wage rate by about 200 percent on an average was observed.

result in variation of  $H$ . Hence the net farm income function of the marginal farmer in second crop production can be expressed as

$$\pi(H, L_H) = PA\{L_F(1+H) + L_H\}^\alpha E^\alpha - C_w - W_M L_F - \beta W_M L_H - L_F^2(1+H)^2 E^2 \dots\dots\dots(2)$$

The last term on the R.H.S of equation (2) stands for the cost of effort<sup>7</sup> incurred by the family labourers to do agricultural work. Cost of effort is expressed in monetary terms and depends on the substitutable choice variables  $H$  and  $L_H$  in case of agricultural production activities. The particular expression in equation (2) belies on the fact that it is convex in nature.  $C_w$  is the cost of water for cultivation which has some potentiality to be explored in our future discussion. As the production is done simultaneously by family labourer and hired labourer, there is little possibility of the emergence of moral hazard problem among the hired agricultural labourers. So we can anticipate the presence of complete information in our model and hence the effort level devoted by each hired labourer in each hour in the production process is observable and same as that in case of family labourers and there is little possibility of shirking among the hired labourers.

Only other alternative of each farm household is to work under MGNREGP when the feasibility of agricultural production comes at stake. Now if the farm household does not carry out agricultural production and want to work under MGNREGP then the net earnings of that household will be

$$\bar{\pi} = L_F e^{-\rho} W_M - L_F^2 a^2 E^2 - R \dots\dots\dots(3)$$

Here ‘R’ is the implicit cost incurred by the farm household for not using the available land for agricultural purposes. The framework of the model conceives that the rural poor comprises of marginal farmers and landless agricultural labourers. Again there is homogeneity among the farming households in respect of land holding. Hence the possibility of leasing out the land is negated as there is no farmer who can take the lease for cultivation. So a farmer either cultivates his land with the help of family labourers and hired labourers or leaves the land uncultivated.  $L_F^2 a^2 E^2$  ( $0 < a < 1$ ) is the cost of effort incurred by the family labourers to do work under

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<sup>7</sup> Cost of effort in general in the model signifies the flavor of opportunity cost of giving effort to do the task either in agriculture or in MGNREGP. In other words, it may be synonymous with the concept of disutility of work.

MGNREGP<sup>8</sup>. Since the Government can time to time change this work effort to be devoted to MGNREGP, therefore 'a' can be conceived of as a policy parameter in our analysis. Besides that a labourer after doing job through MGNREGP does not get wage instantly, rather it takes some time. So the labourer has to bear a few 'patience cost'<sup>9</sup> to get wage through MGNREGP from his/her bank account and that is why we have taken a discounted wage income with  $\rho$  as the discounting factor. It must be noted that with increase in delay of payment,  $\rho$  increases.

Now a farm household will concentrate on agricultural production rather than sending their entire family labour force to do job under MGNREGP only if  $\pi \geq \bar{\pi}$ .

There is a possibility that MGNREGP crowds out agricultural employment. This may lead to lower participation of the poor in the agricultural labour market. On the other hand, higher wages in agriculture will reduce the demand for labour.

Suppose there are 'N' numbers of agricultural labour households and each labour household has only one member who supplies labourer in the labour market. The labourer has two options: (i) working under the farm household as an agricultural labourer where the wage rate is more than the wage rate offered under MGNREGP and the payment is instantaneous, but have to work extensively or (ii) work under MGNREGP where the wage rate is less if we compare that with agricultural wage rate, the payment is delayed but the effort devoted to do one man-day of work is far less than what is required as an agricultural labourer. We have already mentioned that the cost of effort incurred by each labourer doing job under MGNREGP is expressed as  $a^2 E^2$ . So the net earnings of a labourer after doing one man-day job under MGNREGP will be

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<sup>8</sup> During our village level survey in three gram panchayats of South 24 Parganas district and seven gram panchayats of Birbhum district of West Bengal, it is observed that to do one may day work under MGNREGP, each labourer has to dig only 50 cubic feet soil which a standard nourished worker can do within 4 hours and according to them the effort they have to devote to complete this job is almost half of effort they have to devote to do work as an agricultural casual labourer in one day where the working hour is not less than 8 hours.

<sup>9</sup> According to the MGNREGP guideline, payment for worker should be made within 14 days of the completion of the work. However delay in payment and incorrect payments are common problems here. The delay can be for several weeks or sometimes months. Often workers have to make several visits to the bank/post office to find that their wages have not been credited to their accounts. Sometimes delay is also caused because works under MGNREGP are carried out without proper approval.

$$E_{NREGA} = e^{-\rho}W_M - a^2E^2 \dots\dots\dots(4)$$

Now from equation (4) we have

$$\frac{\partial E_{NREGA}}{\partial \rho} = -W_M e^{-\rho} < 0 \text{ and } \frac{\partial^2 E_{NREGA}}{\partial \rho^2} = W_M e^{-\rho} > 0$$

So  $E_{NREGA}$  curve is downward sloping and convex in nature with respect to  $\rho$ . At  $\rho = 0$ , i.e. when payment is instantaneous

$$E_{NREGA} = W_M - a^2E^2 \dots\dots\dots(4A)$$

Again the net earnings of a labourer after finishing one man-day work as ‘hired’ agricultural labourer will be

$$E_{AG} = \beta W_M - E^2 \dots\dots\dots(5)$$

It is clear that  $E_{AG}$  is independent of  $\rho$ .

*Proposition-1: Instant payment in MGNREGP work with given relaxation of assigned job under MGNREGP will reduce the availability of labourers during agricultural production under certain condition even if they are paid more than MGNREGP wage.*

Proof. At  $\rho=0$ ,  $E_{NREGA} > E_{AG}$  provided  $E^2(1-a^2) > (\beta-1)W_M$  i.e. the extra sacrifice a labourer has to do in terms of effort to work as an agricultural labourer is more than the net gain he can enjoy as an agricultural labourer in terms of wage.

Now a labourer will prefer to work as an agricultural labourer rather than working under MGNREGP if and only if  $E_{AG} \geq E_{NREGA}$  and that can happen after a certain value of  $\rho$  say  $\hat{\rho}$  ( $>0$ ) which can be called as the critical value of  $\rho$  at which the net earnings of a labourer under MGNREGP is just equal to  $E_{AG}$  (See appendix I) i.e. when  $\rho > \hat{\rho}$ ,  $E_{AG} > E_{NREGA}$

So in Fig-1 at  $\rho = \hat{\rho}$ ,  $E_{AG} = E_{NREGA}$ .

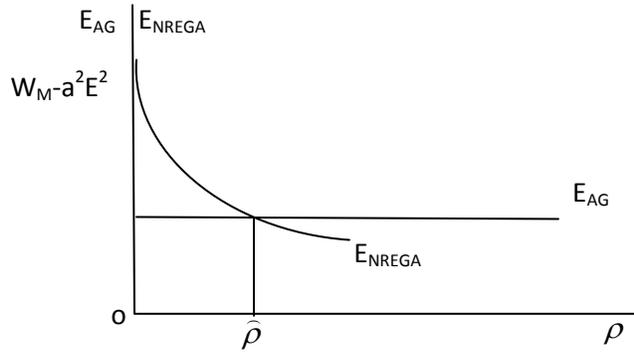


Fig - 1

Determining critical value of  $\rho$  beyond which work through MGNREGP will not be demanded

Fig-1 is drawn based on the premise that the required condition in proposition 1 holds true. From Fig-1 it is obvious that when  $\rho$  is less than  $\hat{\rho}$  then it will be difficult for a farm household to hire agricultural labourer during the time of production even after offering wage more than  $W_M$  because at that situation the rational labourer will always prefer to work under MGNREGP where he has to devote less effort and get payment within short duration after completing one may-day work. So if government initiates payment system within short duration under MGNREGP then demand for work under MGNREGP will increase and it will be difficult to have labour supply in the agricultural production even at much higher wage in post rainy season cultivation.

For the mobility of our model, we stick to  $\rho > \hat{\rho}$  and hence  $\pi > \bar{\pi}$  and  $H < \bar{H}$ .

Securing job through MGNREGP entirely depends on the willingness of the job seekers. If a labourer seeks job through MGNREGP, then local panchayat is bound to provide employment for them. But if  $\rho > \hat{\rho}$ , then employment will be generated in agriculture and the labourers who fail to get job as farm labourers will work through MGNREGP. So in our model, agricultural production can be done if and only if  $\rho > \hat{\rho}$  because then  $\pi > \bar{\pi}$ .

Now considering  $\rho > \hat{\rho}$  and  $\pi > \bar{\pi}$  we ultimately have the following optimization problem of the farm household

$$Max\pi(H, L_H) = PA\{L_F(1+H) + L_H\}^\alpha E^\alpha - C_w - W_M L_F - \beta W_M L_H - L_F^2(1+H)^2 E^2 \dots\dots(6)$$

From Eq.(6), we have

$$\frac{\partial \pi}{\partial H} = 0 \Rightarrow PA\alpha\{L_F(1+H) + L_H\}^{(\alpha-1)} E^\alpha = 2L_F^2(1+H)E^2 \dots\dots\dots(7)$$

$$\frac{\partial \pi}{\partial L_H} = 0 \Rightarrow PA\alpha\{L_F(1+H) + L_H\}^{(\alpha-1)} E^\alpha = \beta W_M \dots\dots\dots(8)$$

Eq.(7) and Eq.(8) give the optimum values of ‘H’ and ‘L<sub>H</sub>’ say  $H^*$  and  $L_H^*$ . The Second order condition is checked in the appendix- II

From Eq.(7) and (8) we can say

$$2L_F^2(1+H^*)E^2 = \beta W_M \dots\dots\dots(9)$$

Therefore, 
$$H^* = \frac{\beta W_M}{2L_F^2 E^2} - 1$$

On the other hand, 
$$L_H^* = \left\{ \frac{\beta W_M}{PA\alpha E^\alpha} \right\}^{\frac{1}{\alpha-1}} - \frac{\beta W_M}{2L_F E^2}$$
 (See appendix-III)

Now we shall investigate about the consequence in agricultural employment generation and production in agricultural sector after hike of MGNREGP wage.

*Proposition-2: Higher wage in MGNREGP tempts the marginal farmer households to reduce the employment of hired labourers.*

Proof: From above, we have

$$\frac{\partial L_H^*}{\partial W_M} = \frac{\beta}{\alpha-1} \left\{ \frac{\beta W_M}{PA\alpha E^\alpha} \right\}^{\frac{1}{\alpha-1}-1} - \frac{\beta}{2L_F E^2} < 0 \dots\dots\dots(10)$$

*Proposition 3: Higher wage in MGNREGP tempts the family labourers to devote more hours for agricultural production.*

Proof: From Eq.(9), we have

$$\frac{\partial H^*}{\partial W_M} = \frac{\beta}{2L_F^2 e^2} > 0 \dots\dots\dots(11)$$

So if government wants to increase  $W_M$  then  $H \rightarrow \bar{H}$  which implies the marginal farmer households will reduce the recruitment of hired labourers and its own family labour force will have to work more than the normal working hour. This establishes the fact that  $H^* = H(W_M)$  and  $L_H^* = L_H(W_M)$ .

Hence the indirect optimum net farm income function of the marginal farmer will be

$$\pi^* = PA[L_F\{1 + H^*(W_M)\} + L_H^*(W_M)]^\alpha E^\alpha - C_W - W_M L_F - \beta W_M L_H^*(W_M) - L_F^2 \{1 + H^*(W_M)\}^2 E^2 \dots\dots\dots(12)$$

Applying Envelope theorem we have

$$\frac{d\pi^*}{dW_M} = -L_F - \beta L_H^* < 0 \dots\dots\dots(13)$$

$$\frac{d^2\pi^*}{dW_M^2} = -\beta \frac{\partial L_H^*}{\partial W_M} > 0 \dots\dots\dots(14)$$

So the maximum net farm income curve of the marginal farmer is negatively sloped and convex in nature which establishes the fact that with the increase of  $W_M$  the maximum net farm income of the marginal farmer household will decrease. So we have to find the critical value of  $W_M$  beyond which the farm household will stop agricultural production for the second crop.

Here  $Min(W_M) = \bar{W}_M$  (see fig-2) i.e. the MGNREGP wage will never become zero but its possible subsistence level is denoted as  $\bar{\pi}$ . We have also mentioned that a marginal farmer household will continue his production as long as it earns at least more than  $\bar{\pi}$ . From equation (3) it is clear that  $\bar{\pi}$  curve is positively sloped and a straight line with respect to  $W_M$ . Now at  $\bar{W}_M$ ,  $\pi^* > \bar{\pi}$ . In figure-2 'k<sub>1</sub>' is the intersection point of these two curves where  $\pi^*$  curve intersects  $\bar{\pi}$  from above and the corresponding level of  $W_M$  will be  $\hat{W}_M$  (say) where the farm

household will be indifferent between his two options in terms of earnings. At  $\hat{W}_M, \pi^* = \bar{\pi}$  holds. (See Appendix IV)

Now when  $W_M$  increases to  $\hat{W}_M$ , there will be change in the critical value of  $\rho$ . When  $W_M \rightarrow \hat{W}_M$  then  $\hat{\rho} \rightarrow \bar{\rho}$  (say), i.e, the prospective MGNREGP workers will be willing to keep more patience than the previous situation if the government hikes the MGNREGP wage per man day towards a limiting value. So at  $\hat{W}_M$ , the labour will be available for agricultural production when  $\rho > \bar{\rho}$ . Hence when  $W_M > \hat{W}_M$  and  $\rho < \bar{\rho}$ , no farmer will be willing to start agricultural production at unchanged  $P$  and  $A$ , because, then  $\pi^* < \bar{\pi}$ .

Hence under the above circumstances, for sustainability of agricultural production in post rainy season, government should not hike one man-day wage under MGNREGP beyond  $\hat{W}_M$ . The following fig-2 also establishes the fact that if due to political pressure or any populist policy, government plans to hike MGNREGP wage beyond  $\hat{W}_M$  then for survival purposes the farmer will have no other option but to hike the price of the agricultural commodity which ultimately may create agricultural price inflation in the economy. It is observed from figure-2 that when  $W_M \in (\hat{W}_M, \overline{W}_M)$  the farmer has no other alternative but to increase the price of the product to make production at least profitable. In Fig-2, the new net farm income curve is denoted as  $\pi^{**}$  when the crop price is increased from  $P_0$  to  $P_1$ . Other wise beyond  $\hat{W}_M$  with  $\rho < \bar{\rho}$ ,  $\bar{\pi} > \pi^*$  which establishes the fact that the farm household has to stop his agricultural production and engage totally in MGNREGP<sup>10</sup>.

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<sup>10</sup> Here it should be mentioned that like Neo-classical type labour market, hike of  $W_M$  will not reduce employment generation through MGNREGP because this public policy is entirely funded by government whose main objective is to generate employment as much as possible.

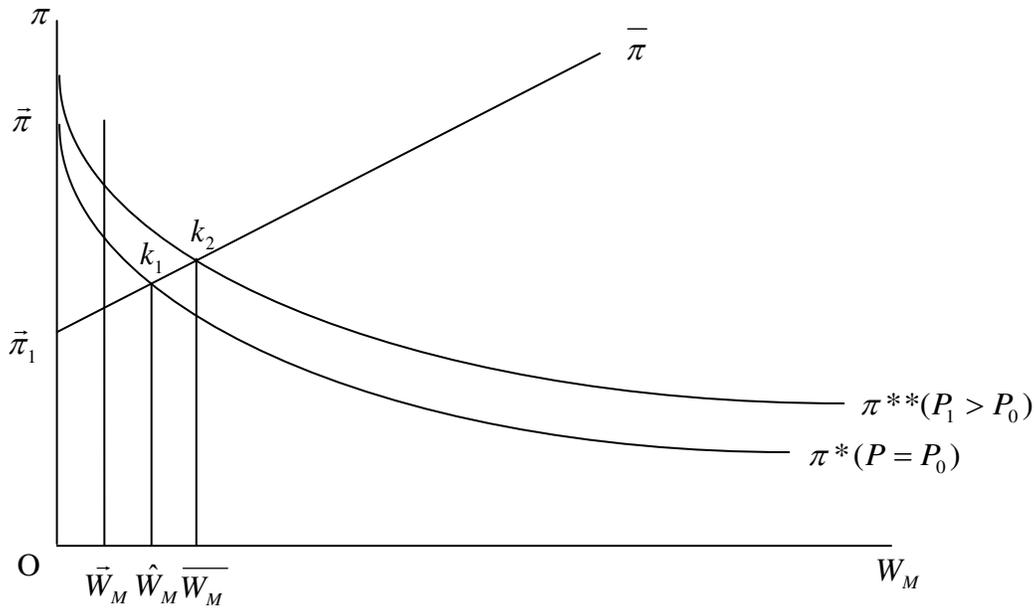


Fig - 2

Determining the critical value of  $W_M$  and citing the possibility of price hike

### III. Perspective on Aggregate Net Pecuniary Benefit of the rural poor in presence of MGNREGP.

There is a growing concern that MGNREGP crowds out private employment (here employment in agriculture) because it is expected that expansion of MGNREGP may lead to lower participation of the poor in the private agricultural labour market. On the other hand, persistent hike in wages in private agricultural employment keeping in pace with the MGNREGP wages will also reduce the demand for labour in private labour market and hence labour may switch over from private to public employment. In this background that it is required to investigate the extent of aggregate net pecuniary benefit of the rural poor (viz. marginal farmers and agricultural labourers) in different contexts such as double cropping and mono cropping regions.

In India, bi-cropping areas cultivate ‘aman’ and ‘boro’ crops so far as paddy cultivation is concerned. The former is cultivated in rainy season when no (minimum) irrigation facilities are required. On the other hand, ‘boro’ crops are cultivated in the winter season when proper irrigation facility is necessary. Moreover, in this season, fertilizers and other inputs are also compulsorily used up. In the present set up we incorporate these features of agriculture and also

presume the nature of employment of labour similar to that in agriculturally developed set up considered in our earlier discussion.

We consider a rural economy where there are  $n$  number of homogeneous marginal farmers and  $N$  number of equally efficient agricultural labourers. Here we subscribe the idea that  $\bar{\pi}$  is the total earnings of a farmer household if he does not get involved in agricultural activity in the winter or second crop production season. On the other hand,  $\pi$  is again the profit of a farmer household from agricultural activity for second crop production in the winter season.<sup>11</sup> Moreover, we consider the parameter ‘ $A$ ’ as before denoting the capital goods used up in agriculture not linked with MGNREGP works. We further hold that  $P = 1$ . Now we consider static one period (say one year) aggregate net benefit function of the rural poor in a village economy in different situations on the basis of the following assumptions.

It is assumed that Aggregate net benefit functions of different agents have one to one correspondence and monotonic relationship with their respective influencing factors, viz, profit for farmers and wage income for landless labourers etc. The analysis is also based on the belief that all adjustments and readjustments pertaining to wage and employment of labourers have already taken place. Now two possible contexts will be narrated.

*Context-1:* Suppose  $\pi \geq \bar{\pi}$  implying that the agricultural production activity is profitable even in a bi-cropping set up for both seasons and the required number of agricultural labourers working in agriculture is  $nL_H$  which remains same in all seasons. In this set up, both cropping seasons are more or less peak seasons which are defined as the busiest times with numerous jobs on the field. The remaining  $(N - nL_H)$  workers will work under MGNREGP. It is confirmed that  $\rho > \bar{\rho}$  and/ or  $W_M < \hat{W}_M$  which ensures relative unattractiveness towards MGNREGP works<sup>12</sup>. Here  $\lambda_M$  is the marginal product or average product in MGNREGP work apart from renovation of water bodies which facilitates irrigation.

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<sup>11</sup> See earlier exposition where  $\pi$  and  $\bar{\pi}$  are carrying the same meaning.

<sup>12</sup> See the earlier section. Here we add the assumption that only those labourers who do not find any agricultural work join MGNREGP. Hence non existence of rural unemployment is here considered.

It is also assumed that  $\lambda_M$  is directly proportional to the material cost involved in the MGNREGP project say,  $Z$ , such as  $\lambda_M = \theta Z$  (where  $\theta$  is constant of proportionality and  $\theta > 0$ ).

Now the aggregate net benefit function in context 1, i.e,  $B_1$  comprises of four parts.

(i). The first part is the net real value of output of  $n$  farmers in agricultural work in the two seasons (viz, aman and boro),

$$[nA\{L_F(1+H) + L_H\}^\alpha E^\alpha + nA\{L_F(1+H) + L_H\}^\alpha E^\alpha - C_w - 2nW_M L_F - 2n\beta W_M L_H - 2nL_F^2(1+H)^2 E^2]$$

Here  $C_w$  is the extra cost of provisioning for agricultural work (say, cost of water) during second crop production season (viz, boro season) which is not environmentally congenial.  $C_w$  is

considered to be a decreasing function of material cost ( $Z$ ) say,  $C_w = \frac{\gamma}{2Z^2}$ . Here

enhancement of  $Z$  will reduce the cost of irrigation, because the major works done under MGNREGP is digging of soil for construction of canals in public land to facilitate irrigation.<sup>13</sup> Moreover  $Z$  in no case here influences  $A$ , it will reduce the cost of cultivation mainly in winter season.

(ii). The second part is the value of output generated under MGNREGP,  $\lambda_M(N - nL_H)$ .

(iii). The third component of  $B_1$  is Net wage incomes of hired labourers in agricultural work,

$$[2\beta nW_M L_H - 2nL_H^2 E^2]$$

(iv). The last part includes net wage income earned through MGNREGP work

$$[e^{-\rho} W_M (N - nL_H) - (N - nL_H)^2 a^2 E^2].$$

<sup>13</sup> According to MGNREGA SAMEEKSHA (2012) published by Ministry of Rural Development, Government of India, with renovation of water bodies, water is available in the canals for up to eight months in a year and this has allowed the farmers to provide 3–6 additional watering to their paddy crops, the renovation increased the crop productivity by around 6–15 per cent, the bulk of the benefits for the farmers came in the form of diesel saving as they were able to replace costly well-irrigation.

$$\begin{aligned}
B_1 = & nA\{L_F(1+H) + L_H\}^\alpha E^\alpha + nA\{L_F(1+H) + L_H\}^\alpha E^\alpha - \frac{\gamma}{2Z^2} - 2nW_M L_F - 2n\beta W_M L_H \\
& - 2nL_F^2(1+H)^2 E^2 + \theta Z(N - nL_H) + 2\beta nW_M L_H - 2nL_H^2 E^2 + e^{-\rho} W_M (N - nL_H) \\
& - (N - nL_H)^2 a^2 E^2 \\
& \dots\dots\dots(15)
\end{aligned}$$

*Context-2:* In monocropping region, when  $\pi < \bar{\pi}$  for the second crop production, then the agricultural production activity becomes non-profitable in case of second crop production because all the agricultural labourers join MGNREGP. Moreover, the farmer household also joins MGNREGP after incurring the opportunity cost of not using the land.  $\rho < \bar{\rho}$  and/or  $W_M > \hat{W}_M$  hold true which makes MGNREGP work attractive. Thus the region remains monocropping where no contestability remains from the point of view of either farmers or landless labourers. Rather, in this case MGNREGP supplements agriculture.

In this case, the specification of the aggregate net benefit function is same as that in context 1 albeit difference in expressions.

(i). The first part is the net real value of output of n farmers in agricultural work as far as first crop production (viz, aman production) is concerned,

$$[nA\{L_F(1+H) + L_H\}^\alpha E^\alpha - nW_M L_F - n\beta W_M L_H - nL_F^2(1+H)^2 E^2 - R].$$

(ii). The second part is the value of output generated under MGNREGP,  $\lambda_M(N + nL_F)$ .

(iii) The third part covers the net wage incomes of hired labourers in agricultural work,

$$\{n\beta W_M L_H - nL_H^2 E^2\}$$

(iv). The last part is composed of the net wage income earned through MGNREGP work,

$$\{e^{-\rho} W_M (nL_F + N) - (nL_F + N)^2 a^2 E^2\}.$$

Hence, the aggregate net benefit  $B_2$  can be expressed as:

$$\begin{aligned}
B_2 = & nA\{L_F(1+H) + L_H\}^\alpha E^\alpha - nW_M L_F - \beta nW_M L_H - nL_F^2(1+H)^2 E^2 - R \\
& + \theta Z(N + nL_F) + \beta nW_M L_H - nL_H^2 E^2 + e^{-\rho} W_M (nL_F + N) - (nL_F + N)^2 a^2 E^2 \dots\dots\dots(16)
\end{aligned}$$

As in the above instance there is distinct compartmentalization of the two activities (agriculture and MGNREGP), hence there is complementarities between them as far as yearly allocation of time is concerned yielding no trade off or contestability framework.

The basic objective of MGNREGP is not only to generate employment among rural labourers in post rainy season, but also to create some assets so that the region can be converted in to at least double cropping regions. So  $B_1 \geq B_2$  is here considered.

Again  $B_1 \geq B_2$  if

$$\begin{aligned} & nA\{L_F(1+H) + L_H\}^\alpha E^\alpha + \{(N + nL_F)^2 - (N - nL_H)^2\}a^2 E^2 + R \\ & \geq nW_M L_F + \{nL_F^2(1+H)^2 + nL_H^2\}E^2 + \theta Z(nL_H + nL_F) + e^{-\rho}W_M(nL_H + nL_F) + \frac{\gamma}{2Z^2} \end{aligned}$$

Which implies that the resultant benefit from bi-cropping nature of cultivation and potential implicit cost of expansion of MGNREGP is more than the potential explicit as well as the implicit costs of agriculture in general and of bi-cropping context in particular and potential benefits from MGNREGP. The following course of analysis will proceed on the basis of the above condition.

The character of the present theory implies that the aggregate net benefit of the rural poor consists of the interests of two sections, viz, marginal farmer households and agricultural labourers. Hence, the aggregate net benefit of the rural poor can be influenced by altering two crucial endogenous decision variables, viz,  $H$  and  $L_H$ . Now our aim is to maximize  $B_1$  with respect to  $H$  and  $L_H$  and analyze the nature of responsiveness of optimum  $B_1$  with respect to  $W_M, Z, \rho$  and  $a$  which can be regarded as the policy parameters here. Thus we have the optimization problem as discussed below where the underlying constraints are  $\rho > \bar{\rho}$  and/or

$$W_M < \widehat{W}_M.$$

$$\begin{aligned} \text{Max } B_1(H, L_H) &= 2nA\{L_F(1+H) + L_H\}^\alpha E^\alpha - \frac{\gamma}{2Z^2} - 2nW_M L_F - 2nL_F^2(1+H)^2 E^2 + \theta Z \\ & (N - nL_H) - 2nL_H^2 E^2 + e^{-\rho}W_M(N - nL_H) - (N - nL_H)^2 a^2 E^2 \end{aligned}$$

Now we have:

$$\frac{\partial B_1}{\partial H} = 0 \Rightarrow 2nA\alpha\{L_F(1+H) + L_H\}^{(\alpha-1)} E^\alpha = 4nL_F^2(1+H)E^2 \dots\dots\dots(17)$$

And  $\frac{\partial B_1}{\partial L_H} = 0$

$$\Rightarrow 2nA\alpha\{L_F(1+H) + L_H\}^{(\alpha-1)} E^\alpha + 2na^2 E^2 (N - nL_H) = 4nL_H E^2 + n\theta Z + ne^{-\rho}W_M \dots\dots(18)$$

From equations (17) and (18) it appears that both  $H$  and  $L_H$  can be solved in terms of  $W_M, \rho, Z$  and  $a$ . Suppose that the optimum values of  $H$  and  $L_H$  are  $H^*$  and  $L_H^*$  respectively.

*Proposition 4: Higher wage in MGNREGP reduces the employment of hired labourers in agriculture and in turn increases the extra hours put in agriculture by the family labourers*

From (17) and (18), we can write<sup>14</sup>

$$4nL_F^2(1+H^*)E^2 = n\theta Z + 4nL_H^*E^2 + ne^{-\rho}W_M - 2na^2 E^2 (N - nL_H^*) \dots\dots\dots(19)$$

From (19) we have,

$$\frac{\partial H^*}{\partial W_M} = \frac{ne^{-\rho}}{4nL_F^2 E^2} > 0 \dots\dots(20)$$

And

$$\frac{\partial L_H^*}{\partial W_M} = \frac{ne^{-\rho}}{-2nE^2(2+na^2)} < 0 \dots\dots(21)$$

Hence the responsiveness of  $H^*$  and  $L_H^*$  with respect to  $W_M$  are respectively positive and negative. Therefore, the optimum values of  $H$  and  $L_H$  respond in the same manner both in individual net farm income and aggregate net benefit contexts.

*Proposition 5: Due to more delay in payment of wages more rural landless labourers will be optimally willing to work as agricultural labourers ignoring the opportunity to work in*

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<sup>14</sup> It is quite clear that finding out the exact expression of  $H^*$  and  $L_H^*$  needs further mathematical techniques. Hence we use equations (17) and (18) again to get the flavor of comparative static results.

*MGNREGP, leading in turn to the fall in the extra hours that the family labour force of the farmer household has to devote in the agricultural work.*

From (19) we have,

$$\frac{\partial H^*}{\partial \rho} = -\frac{n\rho W_M e^{-\rho}}{4nL_F^2 E^2} < 0 \dots\dots (22)$$

$$\text{And } \frac{\partial L_H^*}{\partial \rho} = \frac{n\rho W_M e^{-\rho}}{2nE^2(2+na^2)} > 0 \dots\dots(23)$$

The result shows that as the wage payment in MGNREGP is delayed, the incentive towards joining in MGNREGP work falls. As a result, supply of agricultural labourers to the farming households increases resulting in the fall in the extra hours over and above the normal hours that a farmer household has to devote in the agricultural work.

*Proposition 6: In the short run increase in the material cost enhances the extra effort measured in terms of hours devoted by farming households in agriculture and on the other hand reduces the optimum demand for agricultural labourers in the agricultural activity.*

Again from equation (19), we have,

$$\frac{\partial H^*}{\partial Z} = \frac{n\theta}{4nL_F^2 E^2} > 0 \dots\dots(24)$$

$$\text{And } \frac{\partial L_H^*}{\partial Z} = -\frac{n\theta}{2nE^2(2+na^2)} < 0 \dots\dots(25)$$

The intuition is that an increase in the allocation of material cost increases the productivity of agricultural land. As a result, agricultural output increases at unchanged level of employment. This induces farming households at least in the short run to put extra effort in terms of hours in agriculture followed by reduction in demand for hired labourers.

*Proposition 7: If there is increase in the effort level to be put in MGNREGP work, then the optimum agricultural employment of hired labourers will rise with a corresponding fall in the extra effort in terms of hours devoted by farming households.*

Again from equation (19), we have,

$$\frac{\partial H^*}{\partial a} = -\frac{a(N - nL_H)}{L_F^2} < 0 \dots \dots \dots (26)$$

And  $\frac{\partial L_H^*}{\partial a} = a(N - nL_H) > 0 \dots \dots \dots (27)$

One of the lucrative facts towards joining MGNREGP is the lower effort level vis a vis the agricultural work considering the corresponding wage payment. So if that effort requirement to complete on man-day MGNREGP work becomes high, then the casual labourers have no reasons to stick to MGNREGP with a lower wage as compared with agricultural work with a higher wage and high level of effort.

The ongoing analysis has established the fact that  $H^* = H(W_M, \rho, Z, a)$  and  $L_H^* = L_H(W_M, \rho, Z, a)$ . Hence the optimum aggregate net benefit function of the rural poor will be

$$B_1^*(W_M, \rho, Z, a) = 2nA[L_F\{1 + H^*(W_M, \rho, Z, a)\} + L_H^*(W_M, \rho, Z, a)]^\alpha E^\alpha - \frac{\gamma}{2Z^2} - 2nW_M L_F - 2nL_F^2\{1 + H^*(W_M, \rho, Z, a)\}^2 E^2 + \theta Z\{N - nL_H^*(W_M, \rho, Z, a)\} - 2n\{L_H^*(W_M, \rho, Z, a)\}^2 E^2 + e^{-\rho}W_M\{N - nL_H^*(W_M, \rho, Z, a)\} - \{N - nL_H^*(W_M, \rho, Z, a)\}^2 a^2 E^2$$

*Proposition 8: Enhancement of MGNREGP wage increases the optimum aggregate net benefit of the rural poor if the relative size of the agriculturally unemployed labourers is sufficiently large.*

With the help of Envelope theorem we have,

$$\frac{dB_1^*}{dW_M} = e^{-\rho}\{N - nL_H^*(W_M)\} - 2nL_F \dots \dots \dots (28)$$

The responsiveness of maximum aggregate net benefit of the rural poor with respect to MGNREGP wage is conditional upon the size of agriculturally unemployed labour force vis-à-vis the size of family labour force in a particular village economy. If

$e^{-\rho} \{N - nL_H^*(W_M)\} > 2nL_F$ , then  $\frac{dB_1^*}{dW_M} > 0$  and vice versa. Hence the model prescribes for clear mapping of employment status in area specific manner.

*Proposition 9: The responsiveness of maximum aggregate net benefit function with respect to the delay in payment of wages is unconditionally negative.*

Although  $\rho$  is subjective and depends on individual's perception, yet  $\rho$  can be influenced by the government deliberately as a policy parameter without altering  $W_M$ . From the optimum aggregate net benefit function of the rural poor, we have,

$$\frac{dB_1^*}{d\rho} = -e^{-\rho} W_M \{N - nL_H^*(\rho)\} < 0 \dots (29)$$

Presently wage payment through MGNREGP is done through bank account. This is undoubtedly a positive 'financial inclusion' drive among the rural poor. This also has reduced the intensity of corruption at panchayat level during the time of wage payment. But the poor rural participants always want to get the payment instantly or with in very short time period after completion of job. Sometimes due to administrative inefficiency the payment is delayed and if that happens then that adversely impacts the maximum aggregate net benefit of the rural community in double- cropping areas.

*Proposition 10: Maximum aggregate net benefit function varies directly with the change in material cost. i.e, it is an increasing function of material cost.*

$$\frac{dB_1^*}{dZ} = \frac{\gamma}{Z^3} + \theta \{N - nL_H^*(Z)\} > 0 \dots (30)$$

Thus as allotment towards material cost in MGNREGP increases, aggregate net benefit of the rural poor unambiguously rises. So implementation of MGNREGP in a particular rural area can improve aggregate net benefit through enhancing the feasibility of multiple cropping system which can be regarded as a positive fall out of MGNREGP.

*Proposition 11: Reduction of effort level required to complete one man-day work through MGNREGP enhances the aggregate net benefit of the rural poor.*

Suppose, to complete one man-day work through MGNREGP a labourer has to dig 80 cubic foot soil. But the government decides that a labourer can complete that after digging only 50 cubic foot soil. Then a labourer of MGNREGP has to devote less effort to complete one man-day work.

From the optimum aggregate net benefit function we get

$$\frac{dB_1^*}{da} = -2aE^2 \{N - nL_H^*(a)\} < 0 \dots\dots\dots(31)$$

Given other parameters, if the government reduces the effort level required to complete one man-day work through MGNREGP then it unambiguously enhances the aggregate net benefit of the rural poor in the village economy.

**IV. Concluding observations:**

The constructive impact of MGNREGP has been undeniable. A rise in MGNREGP wage may create a positive economic impact in the sense that it can improve the livelihood of the rural poor. But it has also contributed to rise in farm input costs and withdrawal of labour from farm sector therefore adversely affecting agricultural operation and crop prices viz, food prices. The motivation behind the present theory emerges from this adverse impact of MGNREGP on the agricultural ambience. Section II ends up with a culmination point where ceteris paribus, enhancement of MGNREGP wage above a critical level will stop agricultural activity in post rainy season. Again, keeping an eye on the broad objective of the study (viz, impact of MGNREGP on the rural poor), we evaluate the same in section III by looking at the impact of introducing MGNREGP on aggregate net benefit of the rural poor under the auspices of two different agricultural circumstances. In this regard, a prominent observation is that there arises no conflict between agriculture and MGNREGP from the point of view of the rural poor in mono cropping contexts, rather MGNREGP supplements agricultural employment and income there. Thus it is found that the impact of changes in the relevant policy parameters on aggregate net

benefit in such contexts becomes redundant. But under certain conditions the double cropping systems will give more benefit for the rural poor than single cropping system. It is observed that hike of MGNREGP wage may not benefit the overall rural community. In other situations the effect is unambiguous. So we can have some policy recommendations:

### **Policy implications:**

The impact of MGNREGP and that of subsequently related policy changes need to be reassessed and it cannot be weighted in just political terms. In a nutshell, there is requirement of context specific and region specific policy design and implementation especially pertaining to MGNREGP wage escalation. It also comes out from the model that delay in payment of MGNREGP wage and work effort criteria in MGNREGP are very important factors affecting the decision of a labourer in choosing between agricultural work and MGNREGP work. So a few policies related to some important aspects of MGNREGP are here suggested:

1. Before hiking MGNREGP piece rate government should justify its practical impact on village economy because it should be remembered that it is not always possible for the small and marginal farmers to offer government declared minimum wage to his farm labourers. It is identified that enhancement of MGNREGP wage beyond a limiting value will stop agricultural production and government must refrain itself from reaching out that stage. Apprehension of proper rural employment scenario at village level is a prerequisite in this case. In double cropping region, areas with relatively large number of agriculturally unemployed casual landless labourers can only get the benefit of MGNREGP wage escalation and will make a positive impact on aggregate net pecuniary benefit to the rural poor.
2. Delay in payment of wages has remained a disadvantageous aspect of MGNREGP since its inception. It is observed that the beneficiaries have the only concern regarding the implementation of MGNREGP that the payment should be made in due time. The existing theory clearly shows why it is so. Yet sustenance of agriculture in non rainy season may necessitate a delicate policy mix. If the government plans to raise the MGNREGP wage, it may be accompanied by increase in work effort criteria under MGNREGP and/or delay in payment of wages ( $\hat{\rho} \rightarrow \bar{\rho}$ ) so that availability of labour to agriculture does not drastically fall.

3. MGNREGP work should always be done not only as employment generation programme but also in asset creation which can help the marginal farmers to improve their productivity as well as net farm income in their agricultural production resulting in a positive impact on the aggregate net benefit of the rural poor. This in turn necessitates an adequate increase in the allotment towards material cost in MGNREGP work as and when required.
4. The government should arrange work per man-day under MGNREGP in such a way that the assigned labourer has to work at least 8 hours effectively without shirking. This can be exercised in mono-cropping regions and in those agriculturally developed regions where employment of agricultural labourers is sufficiently large, because in that case the adverse impact on aggregate net benefit is somewhat dampened. This type of programme implementation weakens the power of hindrance towards the supply of labour during the time of agricultural production.
5. Last but not the least; a holistic policy suggestion is that the government should strictly instruct to local panchayat to arrange jobs through MGNREGP only in the agricultural slack season. All the regions in India are not equally developed in agriculture. In many parts of India, we observe the presence of multiple cropping and in those areas the casual labourers are getting job as agricultural labourers more than 150 days annually. If it is observed that the region is agriculturally developed and even the small farmers are cultivating their own land with the help of hired labour more than once in a year then government can reduce the target days of employment generation of each willing household from 100 man-days. This only can reduce the possibility of choice of an agricultural labourer between private employment and public employment through MGNREGP mainly in the agricultural peak season. This only can help the marginal farmers to make their cultivation profitable even at subsistence level through controlling their labour cost.

**Contribution, limitation and future scope of the study:**

The wage rates of agricultural labourers have substantially increased in recent years after the expansion of MGNREGP. Also there has been the phenomenon of workers getting diverted from agriculture and creating shortages of labour in agriculture due to higher wages in MGNREGP.

This model has abstracted the interplay through considering a village economy which consists of two types of vulnerable rural population sections, viz, marginal farmers and landless agricultural labourers. This paper explores the implications MGNREGP in the village economy and subsequent parametric shifts under the same on agricultural employment and income scenario. Moreover, farmers have improved their irrigated areas and changed the cropping patterns for realizing higher productivity and income in areas treated through MGNREGP works making it imperative to reorient wage cost and material cost composition under the scheme. The model has asserted this fact by depicting a favourable impact of material cost on aggregate net benefit of the rural poor.

Bearing the protocol of a theoretical model, the present model is undoubtedly an abstraction from real life disruptions, thus, involving restrictions (eg, non stochasticity and static nature etc). Hence there can be considerable advancements made in the study in future by ameliorating with these restrictions.

Thus in the context of substantial underemployment prevailing in rural areas, the extent to which the theory works is an empirical question. The model is based on total absence of private non-farm employment and migration from/to other places. If those factors are incorporated then the rural labourers in post rainy season will have different types of employment opportunities. That situation may create different impact on local labour market. The impact of MGNREGP on private farm wages in such areas may not be much. The analysis is based on the condition that double cropping can generate much more benefit in the village economy than single cropping. It is required to empirically validate the propositions of the model which again leaves the scope for future research.

## Appendix- I

When  $E_{NREGA} = E_{AG}$ ,

$$e^{-\rho}W_M - a^2E^2 = \beta W_M - E^2$$

$$e^{-\rho} = \beta - \frac{E^2(1-a^2)}{W_M}$$

$$\hat{\rho} = \log \frac{1}{\beta - \frac{E^2(1-a^2)}{W_M}}$$

## Appendix- II

From equation (7) and equation (8) we have

$$\frac{\partial^2 \pi^*}{\partial H^2} = PA\alpha(\alpha-1)\{L_F(1+H) + L_H\}^{(\alpha-2)} E^\alpha - 2L_F^2 E^2 < 0$$

$$\frac{\partial^2 \pi^*}{\partial L_H^2} = PA\alpha(\alpha-1)\{L_F(1+H) + L_H\}^{(\alpha-2)} E^\alpha < 0$$

$$\frac{\partial^2 \pi^*}{\partial L_H \partial H} = PA\alpha(\alpha-1)\{L_F(1+H) + L_H\}^{(\alpha-2)} E^\alpha < 0$$

Now according to second order condition it is observed that

$$\begin{vmatrix} \frac{\partial^2 \Pi^*}{\partial H^2} & \frac{\partial^2 \Pi^*}{\partial L_H \partial H} \\ \frac{\partial^2 \Pi^*}{\partial L_H \partial H} & \frac{\partial^2 \Pi^*}{\partial L_H^2} \end{vmatrix} > 0$$

## Appendix- III

From equation (8), we get

$$PA\alpha\{L_F(1+H^*) + L_H\}^{\alpha-1} E^\alpha = \beta W_M$$

Replacing  $H^*$  from equation (9)

$$PA\alpha\left\{\frac{\beta W_M}{2L_F E^2} + L_H\right\}^{\alpha-1} E^\alpha = \beta W_M$$

$$\left\{\frac{\beta W_M}{2L_F E^2} + L_H\right\}^{\alpha-1} = \frac{\beta W_M}{PA\alpha E^\alpha} \text{ or } \frac{\beta W_M}{2L_F E^2} + L_H = \left\{\frac{\beta W_M}{PA\alpha E^\alpha}\right\}^{\frac{1}{\alpha-1}}$$

## Appendix-IV

The exact expression of  $\widehat{W}_M$  seems to be complicated here. But we come across below the final form of the equation solving which the exact value of  $\widehat{W}_M$  can be obtained.

$$(W_M)^{\frac{\alpha}{\alpha-1}} \left[ \frac{\beta^{\frac{\alpha}{\alpha-1}}}{\alpha P A E} - \frac{\beta^{\frac{\alpha}{\alpha-1}}}{\alpha^{\frac{\alpha}{\alpha-1}} (P A)^{\frac{1}{\alpha-1}} E^{\frac{\alpha}{\alpha-1}}} \right] - W_M [L_F + e^{-\rho} L_F] + W_M^2 \left[ \frac{\beta^2}{2 L_F E^2} - \frac{\beta^2}{2 L_F^2} \right] = C_W - L_F^2 a^2 E^2 - R$$

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