### Model of legal-illegal income substitutability for JFM villages

**Assumptions:**
1. Households belong to poor category (BPL);
2. Households mostly depend on forest source of earning;
3. Income derived from two sources: legal \( Y_l \) and illegal \( Y_i \); and
4. Households involve in illegal income if legal income is inadequate to meet up the bare minimum level of subsistence.

Now we analyse the issue related to forest activities in the short run with following mathematical model (Das and Sarker, 2008:96-99).

Assume \( U_i = U_i(Z_{i1}, Z_{i2}) \) \( ...... (1) \)

where \( Z_1 \) = Commodity (like TFPs) that yields illegal income, \( Y_i \) (measured in time unit), from forest resource; \( Z_2 \) = Commodity (like NTFPs, wage-labour on forest related service) that yields legal income, \( Y_L \) (measured in monetary unit) from forest resource; and \( i = \) Individual \( i \) of poor categories of households which live below poverty line.

Thus we can write

\[
Z_{i1} = Y_{i1}
\]

and

\[
Z_{i2} = Y_{Li}
\]

then \( U_i = f(Y_i, Y_L) \) \( ...... (2) \)

\( Y_i \) is risky and punishable offence for the members of a household if legal authority takes action against the criminal. But its implications seem to be insignificant for the individuals of very poor category of households because \( Y_i \) including \( Y_L \), which would yield illegal income for all \( i \) before JFM programme, was the major source of livelihood security for the same categories of households before JFM programme; moreover after JFM programme \( Y_i \) is one of the major sources of the income for poor individuals in one FPC (Baragari), where legal source of income from forest products is very low in relation to the individuals of poor categories of households in other villages (Table 1.4c). So it is assumed that \( f(Y_i, Y_L) \) is continuous and has first and second order partial derivatives; it is regular strictly quasi-concave function. The rate of substitution of \( Y_L \) for \( Y_i \) is

\[
- \frac{dY_L}{dY_i} = \frac{f_1}{f_2}
\]

But \( Y_i = T_F - [W_L' + W_L] \) \( ...... (3) \)

where \( T_F = \) Total units of available time for forest work by an individual; \( W_L' = \) Total units of available time for the collection of legal forest products like NTFPs and \( W_L = \) Total time
of legal wage work (fixed) under forest department. It is assumed that total available time is 24 hours, and the individual will never work more than 12 hours per day \( \lim_{t \to \infty} (W_L' + \bar{W}_L) = 12 \).

Then the budget constraint is
\[
Y_L = pW_L' + \bar{r} \bar{W}_L 
\]
where \( p = \) price of legal NTFPs; and \( r = \) forest wage rate, which is fixed at \( \bar{r} \).

Thus
\[
U = f(T_F - [W_L' + \bar{W}_L], pW_L' + \bar{r} \bar{W}_L) 
\]

To maximize utility we set the derivative of (5) with respect to \( W_L' \) equal zero
\[
\frac{dU}{dW_L'} = -f_1 + f_2 p = 0 
\]
and therefore
\[
\frac{dY_L}{dY_i} = \frac{f_1}{f_2} = \frac{p}{ \bar{r}} 
\]

This second order condition is satisfied provided that it is negative.
\[
\frac{d^2U}{dW_L'^2} = f_{11} - 2f_{12} p' + f_{22} p^2 < 0 
\]

Equation (6) is a relation in terms of legal forest work \( (W_L') \) and price of legal forest commodities \( (p) \) and is based on the behavior of individual, who live below poverty line. Equation (6) is, therefore, the supply curve for legal forest work and states how much individual \( i \) will legally work at various prices of NTFPs. Since the supply curve of legal forest work is equivalent to demand for legal income, (6) indirectly provides the individual's demand curve for legal income. We also assume that \( Y_1 \) is a normal good. Then hours in legal forest work will increase with the increase of price of NTFPs. The higher price for legal forest products like

![Figure](image-url)
NTFPs will induce the individual i to reduce his illegal work time of forest related work (like collection of TFPs) and so reduces $Y_t$ (see in Figure) so long as individual i's economic condition does not improve. So, the positive relationship between $W_L$ and $p$ and the consequent reduction of $Y_t$ will continue till the point ($P_3$). When the price makes individual i so well off that he is induced to cut down legal working time $W_L$ (i.e. increase the $Y_t$ time) and earn a higher income. But this condition implies a better economic condition (or upward mobility) of very poor categories of individuals. Practically, when the individual will be well off, he will also have more opportunities to increase his income other than forest source. Out study also clearly suggests that more well off individuals are less dependent on income from forest resources (Table 1.4a). So $P_4$ provides an indication that individual i is less dependent on income from forest resource (a better economic condition or an upward mobility of individual i).