Modular E-Learning Lessons

Methodology for Shifting Cultivation-based Livelihood Sustainability Assessment

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ICAR Research Complex for NEH Region, Umiam

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Module I Livelihood Sustainability

- Inception and evolution of the concept
- Sustainable livelihood framework
  - Livelihood capitals
  - Vulnerability context, Policies, and Institutions
  - Livelihood strategies and outcomes

Livelihood Sustainability Concept

Livelihood perspectives have become the focal point in development discourses since the advocacy rendered by Chambers and Conway during the early nineties. Over the years, ‘livelihood’, a seemingly neutral and descriptive word about making a living, has gradually emerged as a ‘boundary term’ that has brought together disparate perspectives, disciplines, professions and institutions to a common understanding (Scoones, 2009). A livelihood comprises the capabilities, assets, and activities required for a means of living. It is deemed sustainable when it can cope with and recover from stresses and shocks and maintain or enhance its capabilities, assets, and activities both now and in the future, while not undermining the natural resource base.

1970s: Many development practitioners were concerned about the famines that were taking place in Africa and Asia, and a concerted effort was made to put more resources into increasing food supplies globally.

1980s: Many development practitioners realized that even with significant national-level surpluses, many households were still not obtaining adequate amounts of food for a healthy life.

Inception and Evolution

It was determined that many households did not have enough income or resources to exchange for food to meet their food needs. This led to a shift from national food security to a concern with the food security and nutritional status of households and individuals. Farming systems research, focusing on the production activities of poor households, also provided a new perspective on the way to view the production and consumption decisions of households.

Mid-1980s - Early 1990s: Researchers began to widen their perspective from food security to a ‘livelihood’ perspective. Some of the first writings on sustainable livelihoods were beginning to appear in the farming systems literature in the late 1980s.

1990s – present: There has been a shift from a material perspective focused on food production to a social perspective that focuses on the enhancement of peoples' capacities to secure their own livelihoods. Much of this thinking is derived from the participatory approaches that have become well integrated into the various implementing agencies' activities for project diagnosis and design.

Sustainable Livelihood Framework

The sustainable livelihoods framework helps to organize the factors that constrain or enhance livelihood opportunities and shows how they relate to one another. A central notion is that different households have different access to livelihood assets, which the sustainable livelihood approach aims to expand. The livelihood assets, which the poor must often make trade-offs and choices about, comprise:

- **Human capital,** e.g., health, nutrition, education, knowledge and skills, capacity to work, capacity to adapt
- **Social capital,** e.g., networks and connections (patronage, neighbourhoods, kinship), relations of trust and mutual understanding and support, formal and informal groups, shared values and behaviours, common rules and sanctions, collective representation, mechanisms for participation in decision-making, leadership
- **Natural capital,** e.g., land and produce, water and aquatic resources, trees and forest products, wildlife, wild foods and fibres, biodiversity, environmental services
- **Physical capital,** e.g., infrastructure (transport, roads, vehicles, secure shelter, and buildings, water supply and sanitation, energy, communications), tools and technology (tools and equipment for production, seed, fertilizer, pesticides, traditional technology)

Livelihood Capitals

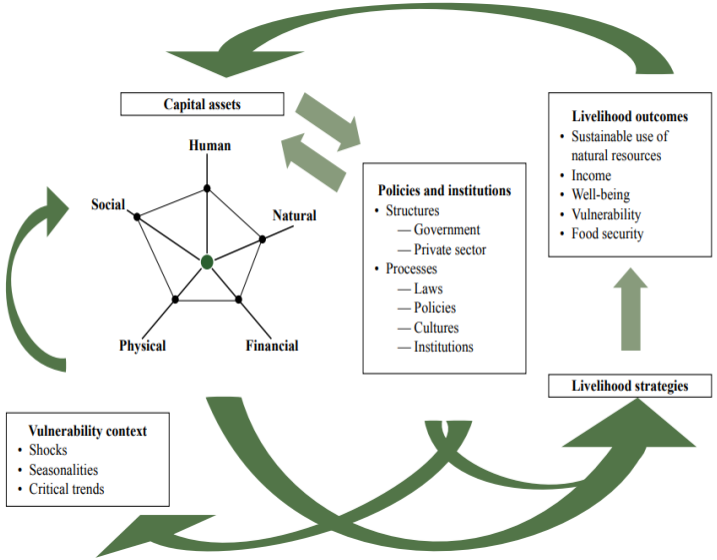

Fig. 1: Sustainable livelihood framework (Source: DFID)

- **Financial capital,** e.g., savings, credit and debt (formal, informal), remittances, pensions, wages.

Vulnerability context, Policies, and Institutions

Vulnerability is characterized as insecurity in the well-being of individuals, households, and communities in the face of changes in their external environment. People move in and out of poverty and the concept of vulnerability captures the processes of change better than poverty line measurements.

It has two facets –

- An external side of shocks, seasonalities, and critical trends; and
- An internal side of defencelessness caused by a lack of ability and means to cope with these.

The vulnerability context includes -

- Shock, e.g., conflict, illnesses, floods, storms, droughts, pests, diseases
- Seasonality, e.g., prices, and employment opportunities
- Critical trends, e.g., demographic, environmental, economic, governance, and technological trends.

Policies and Institutions

Livelihood strategies and outcomes are not just dependent on access to capital assets or constrained by the vulnerability context; they are also transformed by the environment of structures and processes.

Structures are the public and private sector organizations that set and implement policy and legislation; deliver services; and purchase, trade, and perform all manner of other functions that affect livelihoods. Policy-determining structures cannot be effective in the absence of appropriate institutions and processes through which policies can be implemented. **Processes** embrace the laws, regulations, policies, operational arrangements, agreements, societal norms, and practices that, in turn, determine the way in which structures operate. Processes provide incentives that stimulate people to make better choices. They grant or deny access to assets. They enable people to transform one type of asset into another through markets. They have a strong influence on interpersonal relations. One of the main problems the poor and vulnerable face is that the processes which frame their livelihoods may systematically restrict them unless the government adopts pro-poor policies that, in turn, filter down to legislation and even less formal processes.

Livelihood Strategies and Outcomes

Livelihood Strategies and Outcomes

Livelihood strategies aim to achieve livelihood outcomes. Decisions on livelihood strategies may invoke natural-resource based activities, non-natural resource based and off-farm activities, migration and remittances, pensions and grants, intensification versus diversification, and short-term versus long-term outcomes, some of which may compete. One of the many problems of development is that projects and programmes, while favouring some, can disadvantage others.

Livelihood outcomes can include more income, increased well-being, reduced vulnerability, improved food security, more sustainable use of the natural resource base, and recovered human dignity, between which there may again also be conflict.

Implications

The sustainable livelihoods approach encourages thinking out of the box.

- ✓ It frees development practitioners from conventional approaches that are often restricted to identifying problems and finding solutions.
- ✓ It invites them to look at contexts and relationships so that development activities can become more process-oriented.
- ✓ It compels them to look for multiple entry points and to move beyond a homogenous “community” view and a narrow sectoral perspective.
- ✓ It stresses the importance of understanding institutions by mapping the institutional framework and linking the micro to the macro and the formal to the informal.
- ✓ It calls for a new style of policy appraisal that moves from universal prescriptions to context-specific approaches that allow alternative, local perspectives to reveal themselves in the policy framework.

Module II Shifting Cultivation

- A brief acquaintance with shifting cultivation
- The shifting cultivation process
- Concerns, and potential for transformation

A Brief Acquaintance with Shifting Cultivation

Shifting cultivation-based livelihoods perhaps have received the least paid attention so far in national agricultural policies, in spite of the fact that shifting cultivator households encounter the most terrible livelihood challenges day in and day out.

Shifting cultivators are mainly concentrated in the mountainous and hilly parts of Latin America, Central Africa, and the Southeastern part of Asia. They comprise two third of the world's estimated 370 million indigenous people, the Southeastern part of Asia alone harbors 34 million shifting cultivators, belonging to different ethnic minorities. It is the predominant form of farming, practiced since time immemorial in several remote hilly ranges of India also. This specific form of land use has been termed in different ways in scientific literature, like rotational bush, fallow agriculture, shifting cultivation, swidden agriculture, slash-and-burn cultivation etc. In India, it is most popularly known as *jhum*, and its practitioner(s) as *jhumia(s)*. Shifting cultivation areas in the NER have declined by about 75% between the years 2000 and 2010 (Table 1).

Crops cultivated under shifting cultivation system

Traditionally, shifting cultivators used to grow only food grains and vegetables. However, most communities have shifted to the cultivation of cash crops such as ginger, turmeric, pineapple, and jute, among others.

Among food grains, the traditional varieties of rice, followed by maize, millet, Job's-tears, and small millets are the principal crops. Among vegetables, a variety of legumes, potatoes, pumpkins, cucumbers, yams, tapioca, chilies, beans, onion, and arum are cultivated. In fact, the choice of crop is mostly consumption-oriented. Ginger, linseed, rapeseed, perilla, orange, pineapple, and jute are the important cash crops grown in *jhum* fields.

Table 1: Changes in the extent of shifting cultivation areas in NER from 2000 -2010

NE State	Area under shifting cultivation in 2000	Area under shifting cultivation in 2010	Km^2 Change	% decadal change
Arunachal Pradesh	3088.08	1531.46	-1556.62	-50.41
Assam	8391.48	239.56	-8151.92	-97.15
Manipur	12014.06	852.2	-11161.86	-92.91
Meghalaya	2086.77	448.99	-1637.78	-78.48
Mizoram	3761.23	2617.56	-1143.67	-30.41
Nagaland	5224.65	2827.74	-2396.91	-45.88
Tripura	400.88	254.11	-146.77	-36.61
NER	**34967.15**	**8771.62**	**-26195.53**	**-74.91**

The Shifting Cultivation Process

The steps followed in shifting cultivation across Northeastern region of India are briefly discussed below:

1. Selection of forested hilly land - The process of shifting cultivation begins with the selection of a plot on or near the hillside or jungle by the village elders, clan leaders, and households, usually from October to December. At the time of allotment of plots, the size and workforce in the family are taken into consideration. It rationalizes labour availability, and is based on the principle of 'mouths to feed'. The area allotted per family varies from half hectare to one hectare among different tribes and in different states in the region.

2. Clearing of forest - The process of clearing the plots, which can take over a month, is labour-intensive and undertaken almost entirely with indigenous and traditional equipment.

3. Leaving the cleared forest land for drying - Households remove useful biomass – big branches, trunks and boles – for house building, timber and fuelwood requirements, while the remaining debris is left to dry.

4. Burning the dried forest wood into ashes and incorporation - The dried slash as well as the standing tree trunks in the cleared area are set on fire between February and March, care being taken to ensure that fires do not spread out of control during firing operations.

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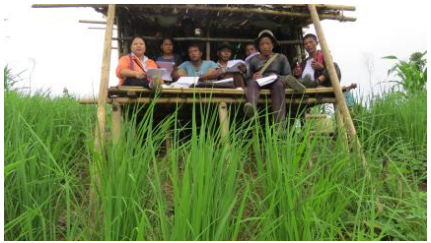
The Method of Shifting Cultivation (Contd…)



5. Worship and sacrifice - Most interestingly, before sowing starts, evil spirits and village deities are worshipped and sacrifices are made for a good crop and prosperity of the family.

6. Sowing - The ashes are then scattered over the ground and dibbling of seeds begins soon after, before the advent of monsoon. The dibbling and planting of seeds is the exclusive job of women. The men broadcast seeds of crops like millets and small millets, whereas crops like maize, pulses, cotton, sesame and vegetables are dibbled by women.

7. Weeding and crop protection - With the advent of rains, the seeds begin to germinate. In shifting cultivation, the soil is never ploughed or irrigated. After sowing, the shifting cultivators tend to the crops regularly by removing weeds. In some places the crop is protected from stray cattle and wild animals by fencing the fields with bamboo. Many shifting cultivators in the region have the custom of constructing a hut in the field to look after the crop.

8. Harvesting and threshing- Shifting cultivators in general practice mixed cropping but the composition of crops varies from tribe to tribe within the region. In mixed cropping, soil-exhausting crops like rice, maize, millets, and cotton and soil-enriching crops like legumes are grown together. These crops are harvested at different periods, thereby providing the farmers with sequential harvesting and a variety of foods throughout the year.

9. Fallowing – In shifting cultivation, the land is cropped for 2-3 years and thereafter fallowed to allow it to recuperate. A *jhum* cycle comprises the period of slash and then coming back to the same plot after completion of the intervening fallow period. Earlier the fallow period used to be 10-15 years, which has now reduced only to 2-3 years in many areas.

Given the difficult terrains in the hills of Northeastern region, shifting cultivation provides a base for low-input agricultural operations in the region. However, indiscriminate jhumming over the past few decades has generated several concerns among the academicians, researchers, administrators, and policy makers as follows:

1. **Soil degradation** - One of the most important negative environmental impacts of shifting cultivation is the damage it causes to the soil system. It accelerates soil erosion manifold and is responsible for the loss of soil nutrients, and important soil fauna and microbes. It results in the lowering down of soil carbon, nitrogen, and magnesium. Although soil phosphorus and cations are enhanced, soil acidity, organic matter, and total nitrogen dips down due to buring.

2. **Forest degradation** - Shifting cultivation is the single most factor considered for forest degradation and deforestation in the Northeastern region of India. Due to the burning of forests, it causes air pollution. Loss of primary forests and tree diversity adapted to the primary forests is another important concern.

3. **Land degradation**- The repeated use of lands with shortened jhum fallows ultimately results in degraded wastelands.

Potential for transformation

1. **Cash crop cultivation** - Broom grass cultivation in Meghalaya; rubber and tea in Tripura; tea in Manipur, Meghalaya, and Arunachal Pradesh; cashew nut plantation in the Garo Hills of Meghalaya; floriculture in Mizoram and passion fruit cultivation in Nagaland, Manipur and Mizoram are a few examples where cash crop cultivation has transformed shifting cultivation.

2. **Agroforestry and fallow forestry** - The Nagaland Empowerment of People through Energy Development (NEPED) has improved *jhum* by introducing a strong component of agroforestry. Large-scale plantation of fast-growing timber and economically important tree species with intercropping of ginger, turmeric, black pepper, and lemongrass has proved to be a viable option. NEPED's approach of encouraging the planting of native tree species for provisional and regulatory services has proved to be an excellent model for fallow forestry in Nagaland.

3. **Models developed by R&D institutions** - A good number of hill farming models have been developed by the national research institutes viz., ICAR, GBPNIHESD, etc., and have been demonstrated across several villages with success.

Module III

Sustainable Livelihood Index

w.r.t shifting cultivation

- Livelihood sustainability indicator
  - Identification
  - Measurement
- Data generation
- Construction of Sustainable Livelihood Index

Identification of livelihood sustainability indicators

Indicators selected for a specific purpose of the study should be simple, transparent, and cover all major aspects concerning the theme as exhaustively as possible. The livelihood sustainability indicators should be credible, rapidly available, communicable to end users, consistent to answer policy questions, and strongly rooted in conceptual and theoretical frameworks.

Indicators can be initially identified and screened after an exhaustive search of available literature, discussing with experts, and using personal experiences, intuition, and wisdom.

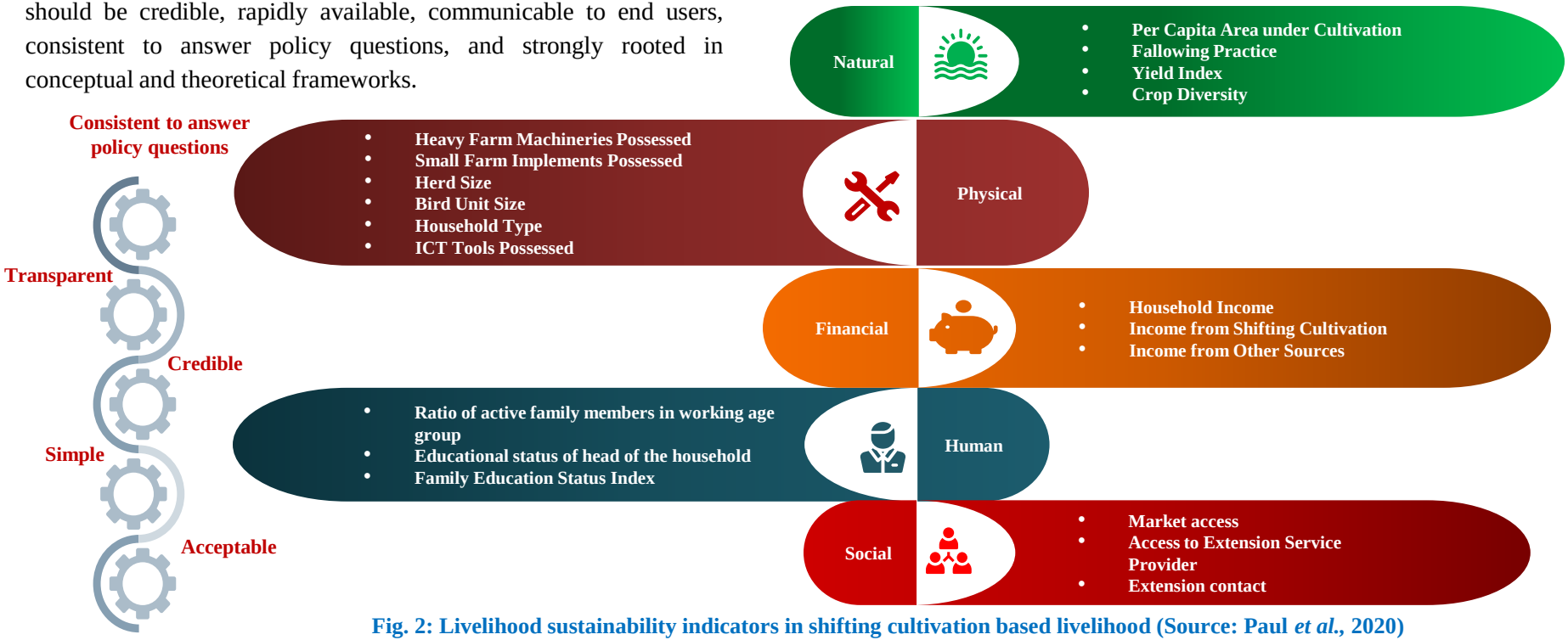


Fig. 2: Livelihood sustainability indicators in shifting cultivation based livelihood (Source: Paul *et al.*, 2020)

Measurement of livelihood sustainability indicators

	Indicator	Measurement
Natural	Per capita area under cultivation	Net sown area (in ha.) of the farm household divided by total number of members in the family
	Fallowing practice	Arithmetic mean of the number of years of fallow maintained for the last three consecutive terms of shifting cultivation
	Yield index	∑(production in q. X price in Rs. for each major crop cultivated)/ total area (in ha.) under shifting cultivation of major crops
	Crop diversity	Simpson Index of Crop Diversity (SICD) = $1-\Sigma P_i^2$;where, $P_i = A_i / \Sigma A_i$ (i.e., the proportion of the i^{th} crop in acreage)
Physical	Small farm implements possessed	Total number of all types of small farm implements possessed by the household
	Herd size	Total number of animals (including dairy, goatery and piggery) possessed by the shifting cultivator household
	Bird unit size	Total number of birds (poultry and duck) possessed by the shifting cultivator household
	Household type	Measured in ordinal level, e.g., no permanent house=0, thatched roof + thatched/wooden wall = 1, thatched roof + stone + mud wall= 2, stone/tin/tile roof + stone/wood/brick/bamboo + mud/cemented wall = 3
	Use of ICT	Total number of ICT tools, e.g., mobile phone, radio, computer set with internet connectivity used for cultivation purposes.
Financial	Income from shifting cultivation	Per capita average annual income (in Rs.) of the farm household from selling of produce from the shifting cultivation
	Income from other sources	Per capita average annual income (in Rs.) of the farm household from sources other than shifting cultivation
	Household income	Per capita average annual income (in Rs.) of the shifting cultivator family from all sources
Human	Ratio of active family members in working age group	Total number of members in a shifting cultivator family in the age group of 18-60 Yrs. divided by family size
	Educational status of head of the household	Measured at ordinal level: Illiterate =0, Primary=1, High school=2 Higher secondary =3, Graduate & above=4
	Family Education Status Index (FESI)	Sum of scores of educational attainment of each family member of the household divided by effective family size (no. of members > 4 yrs. of age)
Social	Market access	Reciprocal of distance (in Km.) of the nearest market in which shifting cultivation produces are sold.
	Access to extension service provider	Reciprocal of distance (in Km.) of the nearest extension service agency, e.g., Farm Science Centre (Krishi Vigyan Kendra), Agricultural Technology Management Agency (ATMA), NGOs etc.
	Extension contact	Measured in terms of frequency of contact with the nearest extension service agency.

Data Generation

The process of generating data depends upon the type of data intended to be used. Paul *et al*. (2020) in their effort to analyze livelihood sustainability of shifting cultivators of the Northeastern region of India used household survey based cross sectional primary data, collected through personal interviews with the help of a structured personal interview schedule. Their sample comprised randomly selected forty four villages from eleven districts of the seven NE states. They selected two districts each from the states of Arunachal Pradesh, Manipur, Mizoram and Nagaland, and one district each from Assam, Meghalaya and Tripura.

From each district, they randomly selected four villages and from each village fifteen shifting cultivator households. So, initially they surveyed a total of six hundred and sixty shifting cultivator families representing fifteen different tribes. Due to ambiguity, non-response in certain parameters and incompleteness, they discarded the data of thirty nine households. Therefore, the final sample of their study consisted of a total of six hundred and twenty one shifting cultivator households (n=621).

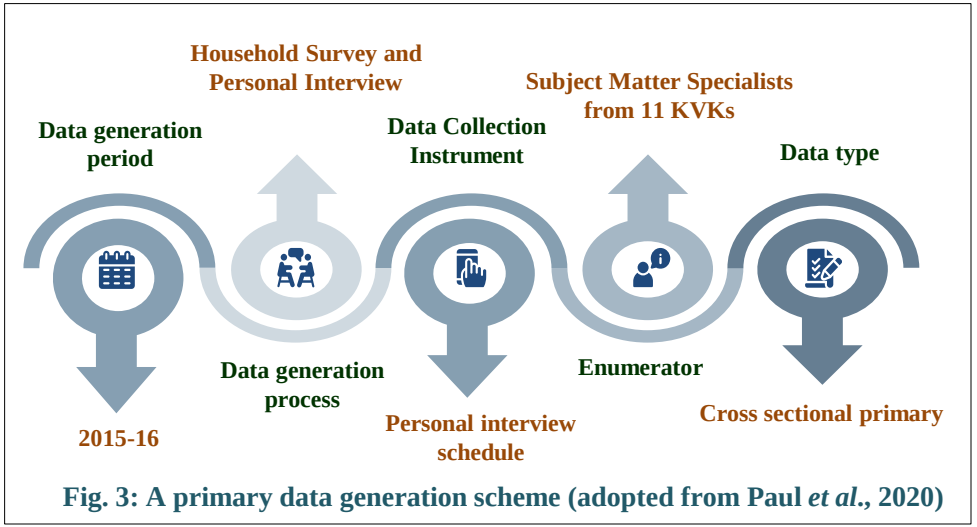


Fig. 3: A primary data generation scheme (adopted from Paul *et al*., 2020)

Construction of livelihood sustainability index (LSI)

Steps in LSI construction

Step 1: Normalization of indicators

As the scales and units of measurement of the indicators may not be uniform, the range-based method may be applied to normalize the positive and negative indicators. Positive indicators are those which are considered better if their values were larger; the reverse consideration is made for negative indicators.

$$y^{p}_{ij} = (x_{ij} - x_{j\,min}) / (x_{j\,max} - x_{j\,min})$$ (where, [i]=1,2,…,[n], and [j]=1,2,…,[m])

$$y^{n}_{ij} = (x_{j\,max} - x_{ij}) / (x_{j\,max} - x_{j\,min})$$ (where, [i]=1,2,…,[n], and [j]=1,2,…,[m])

Here, y^{p}_{ij} refers to the normalized positive indicator, y^{n}_{ij} refers to the normalized negative indicator, $x_{j\,min}$ refers to the minimum value of the sample under evaluation for indicator j, and $x_{j\,max}$ refers to the minimum value of the sample under evaluation for indicator j.

Step 2: Calculation of proportion of evaluation targets (f_{ij})

$$f_{ij} = y_{ij} / \sum_{i=1}^{m} y_{ij}$$ (where, [j] = 1,2,…,[n])

Step 3: Calculation of entropy value of indicator j (H_j)

$$H_j = - h_0 \sum_{i=1}^{m} f_{ij} \log (f_{ij})$$

(where h_0 is the entropy constant and is equal to $(\log (m))^{-1}$ and $f_{ij}.\log (f_{ij})$ is defined as 0 if $f_{ij} = 0$).

Step 4: Calculation of entropy weight of indicator j (w_j)

$$w_j = (1 - H_j) / \sum (1 - Hj)$$ (where, $w_j \in [0,1]$, $\sum_{j=1}^{n} w_j = 1$)

Step 5: Calculation of index value

The index values are calculated using the entropy weights calculated for the indicators as above and multiplying the weight with unweighted index values calculated for the positive and negative indicators as below:

$$Z^{p}_{i} = 1 - (S_i - C_i) / (S_i - S_{min})$$

$$Z^{n}_{i} = 1 - (C_i - S_i) / (S_{max} - S_i)$$

Where, C_i is the actual value, S_i is the reference value (sample mean) of the indicator, S_{max} is the maximum value, S_{min} is the minimum value of the evaluation sample under the particular indicator.

Step 6: A multi-objective linear weighting function evaluation model

It may thereby be used to work out the value of a comprehensive LSI:

$$LSI = \sum_{j=1}^{n} {}_{w_j} \times Z_{ij}$$

Module IV Way Forward

- Implications of the LSI
- Recommendations

Implications of the LSI

Given the socioeconomic vulnerability of the shifting cultivator communities in the entire NE region, it is quite obvious that any positive change to take effect in the status of livelihood sustainability will require long-term handholding support. Although frontline demonstrations, training, distribution of critical inputs, and agro-advisory services on improved technologies are provided to them mainly by the respective district KVKs, they are very limited in terms of outreach.

Development planning traditionally aims at poverty eradication. Poverty estimation in India is largely carried out based on absolute measures. In this regard, looking at poverty from the sustainable livelihood perspective is advantageous for its holistic consideration of the resources under access. It facilitates the enrichment of understanding and helps in better decision-making as the sustainable livelihood framework fits as an instrument aiding development planning in a more holistic manner.

The implications of the LSI are clear: (1) the efforts for improvement of shifting cultivation-based livelihood in the region have so far been addressed in bits and pieces, and the LSI can help in understanding development perspectives holistically, (2) the existing poverty-short fallow trap will hardly allow the shifting cultivators to maintain a long enough crop-fallow cycle, and thus will further risk the environment. Therefore, livelihood sustainability has a direct environmental implication.

A study conducted by Paul et al., 2020 in this regard, suggests that shifting cultivator households of Mizoram and Nagaland, and to some extent, Manipur are comparatively better off in terms of livelihood sustainability when compared to Arunachal Pradesh, Assam, Meghalaya, and Tripura. The Sustainable Livelihood Index as developed in course of their study may fruitfully be utilized as a great indicator of development that takes place over time. Their analysis highlights the importance of livelihood diversification, market infrastructure development, and building extension contacts for livelihood sustainability.

Recommendation

The following suggestive steps can be followed for further precision and credibility of the LSI:

(1) The LSI may suffer from sensitivity to ‘changes’ unless it is tested for robustness. Here, changes refer to change(s) in the weighting scheme(s) and change(s) in the variable(s). Alternate forms of the LSI using different weighting schemes such as normalized indicator aggregation (NIA), PCA method, Borda method etc. can be used.

Normalized indicator aggregation refers to the linear summation of normalized values across variables assuming equal weightage for all the variables. The sum of normalized values represents the alternate form of the index.

Borda method is a preferential, rank based weighting system in which we first rank all the households under each of the studied variables based on absolute values of the variable and then derive a Borda score for the corresponding ranks. Higher the rank, lower is the Borda score.

Linear summation of Borda scores across the variables gives the index values of the households. The final ranks are generated based on the summated Borda scores across variables.

A comparison between the sets of ranks generated using the different methods, one proposed, and the other alternate forms can be done. The Spearman’s rank correlation coefficients (ρ) among the proposed and comparison methods may be worked out. It can help in assessing the degree of correspondence between rankings, implying the sensitivity and robustness of the constructed index.

2. The scope of the LSI may be further extended by integrating biophysical and agro-climatic indicators in the present framework. Measurement and integration of of soil quality, soil biodiversity, and stability of climatic parameters may add value to the LSI.

3. For larger acceptance and use, the LSI may be validated with the help of an external construct, not built-in to the present framework.