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Crop Diversification an Effective Strategy for Sustainable Agriculture Development

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The term 'diversification' is derived from the word 'diverge,' which meaning extend in a different direction than a common point. Agricultural intensification enhanced crop output while simplifying production by reducing crop diversity, increasing genetic homogeneity, and uniformizing agricultural landscapes. The associated negative consequences on the ecosystem and biodiversity, as well as farming system resilience and adaptability to climate change, are causing considerable concern. Agricultural diversification may increase crop yield while decreasing negative environmental impacts and biodiversity loss, however there is a lack of a shared understanding of crop diversification, including ways to more systematic study.

Why does India need crop diversification?

It can help to boost agricultural productivity by lowering the chance of crop failure due to pests, illnesses, or bad weather. Farmers can spread their risk and lessen their reliance by cultivating a variety of crops.It can assist to improve the nutritional value of diets by making a wider variety of foods more accessible. This is especially significant in areas where people are at risk of malnutrition or rely on a restricted variety of staple crops.It can aid in biodiversity conservation by encouraging the cultivation of a broader range of crops and relieving pressure on a few dominating crops. This can aid in the preservation of ecosystem services like soil fertility, pollination, and pest control.

It can contribute to lower greenhouse gas emissions by encouraging the production of crops that require fewer inputs such as fertilizers and pesticides. This can assist to minimize climate change and reduce agriculture's environmental impact.

Challenges in adopting crop diversification

- Rainfall is responsible for more than 60% of the country's cultivated area. As a result, areas with less rain have fewer crop diversification options.

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- A scarcity of high-quality seeds and planting materials appropriate for regional climates.
- Farmers lack knowledge of this practise and lack guidance on how to successfully implement it because there is a poor link between farmers and research-extension.

Strategies For Crop Diversification

- Shifting from low yielding low value crops to high yielding high value crops.
- Shifting toward higher water requirement crop to lower requirement crops.
- Shifting toward low energy efficient crop to higher energy crop
- Inclusion of legumes and oilseed crops 5. Inclusion of crop which has national and international market demand

Crop Diversification Index:

The various indices used to study crop diversification are explain here as under:

Let $P_i$indicates the proportion of Area under the i^{th} crop.

1. Index of Maximum Proportion:

It is maximum proportion held by i^{th} crop in total cropped area and denoted by D_1. It is a measure of concentration of crops.It decreases with increasing diversification.

D_1 = Max P_i; $i = 1, 2, \ldots, r$, Where r is the total number/ types of crop and

$$Proportion\ of\ area\ under\ i^{th}\ crop\ (P_i) = \frac{Actual\ area\ under\ i^{th}\ crop}{Total\ cropped\ area}$$

2. Entropy Index:

It is having logarithmic character and is inverse measure of concentration. The range of Entropy index is 0 to 1.

$$D_2 = \sum_{i=1}^{r} P_i \log\left(\frac{1}{P_i}\right)$$

3. Herfindahl – Hirschman (HHI) Index:

It is measure of competitiveness of crops in terms of concentration. It is used to measure extent of crop diversification and contribution of a particular crop, in terms of area occupied, in a region. It ranges from 0 to 1. Higher value of index shows decreased competitiveness between crops and increased monopoly by single crop. If value of D_3 is 0, shows complete diversification and 1, shows complete specialization.

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$$D_3 = \sum_{i=1}^{r} P_i^2$$

4. Simpson's Diversification Index (SDI):

This index is developed by Edward H. Simpson in 1949. Simpson's index is a weighted arithmetic mean of proportional abundance measuring the probability that two individuals randomly selected from a sample will belong to the samespecies. Since the mean of the proportional abundance of the species increases with decreasing number of species and increasing abundance of the most abundant species, the value of obtains small values in data sets of high diversity and large values in data sets with low diversity. The value of Simpson's ranges from 0 to 1, with 0 representing infinite diversity and 1 representing no diversity.

$$D_4 = \sum_{i=1}^{r} \left(\frac{n_i(n_i - 1)}{N(N-1)} \right)$$

Where, n_i is the number of individuals in species *i*, *i=1, 2,… r*; and *N* is the total number of all species in the sample.

5. InverseSimpson's Diversification Index and Gini-Simpson Index:

The value of Simpson's index ranges from 0 to 1, with 0 representing infinite diversity and 1 representing no diversity. So the larger the value of D_4, the lower the diversity. For this reason, Simpson's index is also expressed as its inverse, which is known as Inverse Simpson's index.

$$D_5 = \left(\frac{1}{D_4} \right)$$

Or its compliment which is also known as the Gini-Simpson index

$$D_6 = (1 - D_4)$$

6. Alternative Gini-Simpson Index (AGSI)

Gini-Simpson Index is defined above as the reverse of Simpson index. Actually, it mainly represents the reverse of concentration of crops in terms of weighted average of number of crops occupying an area in a region. This can also be alternatively defined as the reverse of the weighted average of the proportion of area occupied by a crop in a given region. Thus, the Alternative Gini-Simpson Index (AGSI) is given as

$$D_7 = (1 - D_3)$$

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The value of Alternative Gini-Simpson index ranges from 0 to 1, with 0 representing complete specialization and 1 representing complete diversification.

Conclusion

Crop diversification index is an important indicator of the sustainability and resilience of agriculture. By promoting crop diversification, policymakers can help to increase agricultural productivity, improve nutrition, conserve biodiversity, and mitigate climate change.