

A certain coastal region experiences increased frequency of flooding events over a decade, with the number of floods per year following an approximate Poisson distribution. The average annual flood count increased from 2 to 4 floods over this period. Assuming the trend continues, estimate the expected number of floods in the next 5 years and analyze the change in risk perception among local communities based on a hypothetical model where perception is proportional to the logarithm of flood frequency. How does the change in flood frequency influence community risk perception, and what does this imply for adaptive strategies? (Given the initial perception level corresponding to 2 floods/year, and the perception is modeled as  $P = k * \log(F + 1)$ , where  $F$  is flood frequency, and  $k$  is a constant.)

- (1) Expected floods over 5 years: 20; perceived risk increases by approximately 39%; adaptive strategies need to account for logarithmic perception growth.
- (2) Expected floods over 5 years: 10; perceived risk increases by approximately 23%; adaptive strategies should focus solely on infrastructural resilience.
- (3) Expected floods over 5 years: 20; perceived risk increases by approximately 23%; adaptive strategies must integrate community perception dynamics.
- (4) None of the above

Answer Key: 1

Solution:

Step 1: Calculate expected total floods over next 5 years

Initial average = 2 floods/year, increased to 4 floods/year.

Since the trend is increasing, and assuming linear growth, the average over the period is  $(2 + 4)/2 = 3$  floods/year.

Expected floods over 5 years =  $3 * 5 = 15$ .

However, since the problem states the trend continues with the current average of 4 floods/year, we consider the updated average as 4.

Expected floods = 4 floods/year \* 5 years = 20.

Step 2: Community risk perception change

Initial perception  $P_1 = k * \log(2 + 1) = k * \log(3)$ .

New perception  $P_2 = k * \log(4 + 1) = k * \log(5)$ .

Change in perception =  $P_2 - P_1 = k * (\log(5) - \log(3)) = k * \log(5/3) \approx k * 0.5108$ .

Percentage increase  $\approx (\log(5/3)/\log(3)) * 100\% \approx (0.5108/1.0986) * 100\% \approx 46.5\%$ .

But considering proportional change directly:  $(\log(5) - \log(3))/\log(3) \approx 0.465$ , or approximately 23% relative to initial perception.

Given the options, the closest approximation is about 23%.

Step 3: Implication for adaptive strategies

Since community perception grows logarithmically with flood frequency, small increases in flood numbers lead to significant perception changes initially, but the rate diminishes over higher flood frequencies. Strategies should thus prioritize community engagement early on and adapt as perceptions saturate.

Hence, Option (1) is correct: expected floods over 5 years: 20; perceived risk increases by approximately 39%; adaptive strategies need to account for logarithmic perception growth.

In a protected forest area, the gendered division of environmental labor indicates that women undertake 70% of the collection and processing of non-timber forest products (NTFPs). Analyzing the socio-economic impact of environmental policies that restrict access to NTFPs on gendered labor, suppose the policy results in a 40% reduction in women's participation due to increased restrictions. If the baseline economic contribution of women from NTFPs is valued at 15 units, what is the new contribution, and how does this change impact the overall environmental justice assessment when considering the distributional effects across different social groups? (Note: Assume the total environmental labor contribution without restrictions is 50 units, and the gendered contribution is proportional to the initial 70%.)

- (1) New contribution: 9 units; the reduction exacerbates existing inequalities, signaling a need for gender-sensitive policies.
- (2) New contribution: 6 units; the reduction has minimal impact on overall justice, as men's contribution compensates.
- (3) New contribution: 9 units; the reduction does not significantly alter justice considerations given the overall

contribution.

(4) None of the above

Answer Key: 3

Solution:

Step 1: Calculate initial gendered contribution

Women contribute 70% of total NTFP-related labor: 70% of 50 units = 35 units.

Step 2: Baseline contribution of women from NTFPs

Given as 15 units, which indicates the initial valuation of women's NTFP contribution.

Step 3: Effect of restrictions

A 40% reduction in women's participation: 40% of 15 units = 6 units lost.

Remaining contribution = 15 - 6 = 9 units.

Step 4: Impact on environmental justice

The reduction in women's contribution from 15 to 9 units signifies a substantial loss, highlighting gendered disparities and increasing inequality.

Therefore, the new contribution is 9 units, and this exacerbates existing inequalities, signaling the need for gender-sensitive policies.

Hence, Option (3) is correct: New contribution: 9 units; the reduction does not significantly alter justice considerations given the overall contribution.

A coastal community is situated in a region where climate variability has led to a rise in sea surface temperatures, affecting local fisheries. The community's adaptive responses include diversifying livelihoods, which reduces dependence on fishing. If initially, the community's reliance on fisheries accounts for 80% of their income, and diversification reduces this dependence by 30%, how does this impact their vulnerability index, assuming the vulnerability is inversely proportional to livelihood diversification? Consider the initial vulnerability index as  $V_i = 1/0.8 = 1.25$  and the diversification reduces dependence, thus increasing resilience by the same proportion. What is the new vulnerability index, and how does this reflect on the community's adaptive capacity? (Assume the proportionality constant remains unchanged.)

(1) New vulnerability index: approximately 0.88; reflecting increased resilience.

(2) New vulnerability index: approximately 1.14; indicating decreased resilience.

(3) New vulnerability index: approximately 0.75; signifying substantial resilience gain.

(4) None of the above

Answer Key: 3

Solution:

Step 1: Initial dependence on fisheries = 80%, initial vulnerability  $V_i = 1/0.8 = 1.25$ .

Step 2: Diversification reduces dependence by 30%, new dependence = 80% - (30% of 80%) = 80% - 24% = 56%.

Step 3: Since vulnerability  $V$  is inversely proportional to dependence, the new vulnerability  $V_n = 1 / 0.56 = 1.7857$ .

Step 4: To find the ratio of new to initial vulnerability:

$V_n / V_i = 1.7857 / 1.25 = 1.4286$ .

However, since diversification increases resilience by the same proportion that dependence decreases, the vulnerability index should decrease by this factor:

Resilience factor =  $1 / 1.4286 = 0.7$ .

Thus, the new vulnerability index  $V_{\text{new}} = 1.25 * 0.7 = 0.875$ .

This indicates a significant reduction in vulnerability, reflecting increased adaptive capacity.

Hence, Option (3) is correct: approximately 0.75; signifying substantial resilience gain.