1. a. <u>Centralized</u>

$$\max \; u(S,f)$$
$$\text{s.t.} \quad S = S(L_s)$$
$$f = F(L_f, w(S))$$
$$L_s + L_f = \bar{L}.$$

$$L: \; u(s(L_s), F(L_f, w(S(L_s)))) + \lambda(\bar{L} - L_s - L_f)$$

<u>FOC</u>

$$\frac{\partial L}{\partial L_s} = U_s S_{L_s} + U_f F_w W_s S_{L_s} - \lambda = 0 \qquad (1)$$

$$\frac{\partial L}{\partial L_f} = U_f F_{L_f} - \lambda = 0 \qquad (2)$$

$$\frac{\partial L}{\partial \lambda} = L_s - L_f - \bar{L} = 0 \qquad (3)$$

$$\frac{(1)}{(2)} = \frac{U_s S_{L_s}}{U_F F_{L_F}} + \frac{U_f F_w W_s S_{L_s}}{U_f F_{L_f}} = 1$$

$$\frac{U_s}{U_F} + \frac{\cancel{U_f} F_w W_s \cancel{S_{L_s}}}{\cancel{U_f} \cancel{F_{L_f}}} \cdot \frac{\cancel{F_{L_f}}}{\cancel{S_{L_s}}} = \frac{F_{L_f}}{S_{L_s}}$$

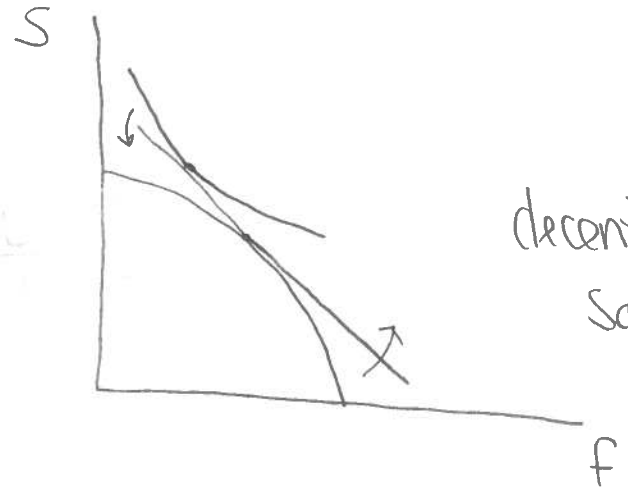
$$\underbrace{\frac{U_s}{U_F} + \overbrace{\underset{+ \;\; (-)}{F_w W_s}}^{(-)}}_{MRS} = \underbrace{\frac{F_{L_f}}{S_{L_s}}}_{MRT}$$

In the centralized case, the producers recognize the negative impact salt has on fisheries.

decentralized

$$\underbrace{\frac{U_S}{U_F}}_{MRS} = \underbrace{\frac{F_{LF}}{S_{LS}}}_{MRT}$$

In the decentralized case the producers and consumer do not recognize the negative externality salt production/consumption has on fisheries.



decentralized scenario = too much salt production compared to socially opt. outcome.

Price ratio $= \frac{-P_f}{P_s}$. To ↓ price ratio and achieve P.O. outcome, ↑ P_s (w/ taxes). Notice w/ an externality, a C.E. ≠ P.O. and requires intervention to achieve P.O.

b. $T = 0$

$t_s = P_f F_w W_s$ } If you add tax $\pi = (P_s + t_s) \cdot S(L_s) - wL_s$

With a tax, P_s ↑ and S ↓ f ↑.

See graph above.

2.

a. $\max\ U_1(x_1, y)$ s.t. $U_2(x_2, y) \geq \bar{U}_2$

$y = 100 - x_1 - x_2$

$L: x_1 + 6\sqrt{y} + \lambda(x_2 + 10\sqrt{y})$ where $y = 100 - x_1 - x_2$.

FOC

$$\frac{\partial L}{\partial x_1} = 1 - 6(0.5)\underbrace{(100-x_1-x_2)}_{y}^{-0.5} - \lambda\left(10(0.5)\underbrace{(100-x_1-x_2)}_{y}^{-0.5}\right) = 0 \quad (1)$$

$$\frac{\partial L}{\partial x_2} = -6(0.5)(100-x_1-x_2)^{-0.5} + \lambda\left(1 - 10(0.5)(100-x_1-x_2)^{-0.5}\right) = 0 \quad (2)$$

$$\frac{\partial L}{\partial \lambda} = U_2(x_2, y) = \bar{U}_2$$

From $\frac{(1)}{(2)}$

$$\frac{1 - \frac{3}{\sqrt{y}}}{-\left(\frac{3}{\sqrt{y}}\right)} = \frac{-\frac{5}{\sqrt{y}}}{\left(1 - \frac{5}{\sqrt{y}}\right)} \quad (3)$$

rearrange (3)

$$\underbrace{\frac{3}{\sqrt{y}} + \frac{5}{\sqrt{y}}}_{\text{Sum of MRS}} = \underbrace{1}_{\text{MRT}} \quad (4)$$

$(\overbrace{\text{sum of WTP}}^{MB} = MC)$

= SAMUELSON CONDITION.

If you solve $4 \Rightarrow \boxed{y = 64}$

b. $MWTP_1 = \frac{3}{\sqrt{64}} = \frac{3}{8}$ $MWTP_2 = \frac{5}{\sqrt{64}} = \frac{5}{8}$ Notice Person 2 has a higher WTP)

3. $U(W) = W^{0.5}$

$200 - \frac{2}{3}$

$300 - \frac{1}{3}$

a. $EW = \frac{2}{3}(200) + \frac{1}{3}(300) \overset{\$}{=} 233.33$

$p(W_1) + (1-p)W_2 = EW$

b. $EU = p\,U(W_1) + (1-p)\,U(W_2)$

$= \frac{2}{3}(200)^{0.5} + \frac{1}{3}(300)^{0.5} = 15.20$

c. $(233.33 - c)^{0.5} = 15.20$

$233.33 - c = 231.04$

$\boxed{c = 2.30}$

d.