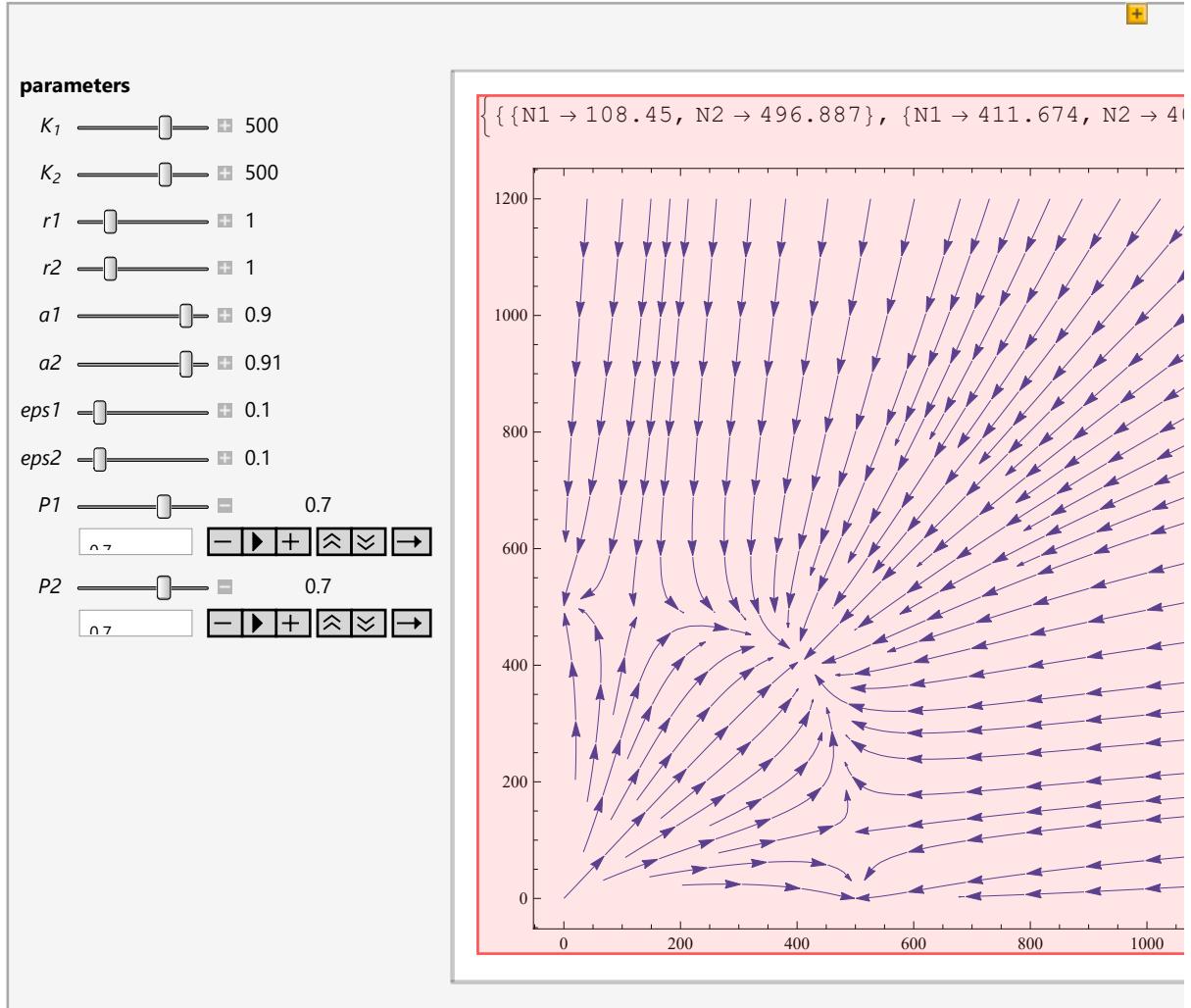


This interactive code generate the phase – plane diagram and the parameters can be modulated with the left – hand side bars. It has been used in Figure 3.

```
In[1]:= h1 := 50; h2 := 50; e1 := 50; e2 := 50;

In[3]:= Manipulate[
 {Solve[r1 * (1 - N1 / K1) - (1 - P1) * a1 * N2 / (e1 + N1) + P1 * eps1 * N2 / (h2 + N2) == 0 &&
 r2 * (1 - N2 / K2) - (1 - P2) * a2 * N1 / (e2 + N2) + P2 * eps2 * N1 / (h1 + N1) == 0 &&
 N1 > 0 && N2 > 0, {N1, N2}],
 ,
 Show[
 StreamPlot[
 {r1 * N1 * (1 - N1 / K1) - (1 - P1) a1 * N1 * N2 / (e1 + N1) + P1 * eps1 * N1 * N2 / (h2 + N2),
 r2 * N2 * (1 - N2 / K2) - (1 - P2) a2 * N1 * N2 / (e2 + N2) +
 P2 * eps2 * N1 * N2 / (h1 + N1)}, {N1, 0, 1200}, {N2, 0, 1200}],
 ],
 ImageSize → {425, Automatic}
 ],
 Style["parameters", Bold],
 {{K1, 500, Style["K1", Italic]}, 1,
 700, 10, ImageSize → Tiny, Appearance → "Labeled"},
 {{K2, 500, Style["K2", Italic]}, 1, 700, 10,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{r1, 1, Style["r1", Italic]}, 0, 5, 0.1,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{r2, 1, Style["r2", Italic]}, 0, 5, 0.1,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{a1, 0.1, Style["a1", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{a2, 0.1, Style["a2", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{eps1, 0.1, Style["eps1", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{eps2, 0.1, Style["eps2", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{P1, 0.5, Style["P1", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"},
 {{P2, 0.5, Style["P2", Italic]}, 0, 1, 0.01,
 ImageSize → Tiny, Appearance → "Labeled"}},
 TrackedSymbols → True,
 ControlPlacement → Left,
 SynchronousUpdating → True]
```



In[155]:=

```
r1 := 1; r2 := 1; K1 := 500; K2 := 500; a1 := 0.1; a2 := 0.9; eps1 := 0.1;
eps2 := 9; h1 := 50; h2 := 50; e1 := 50; e2 := 50; P1 := 0.5; P2 := 0.1;
```

In[158]:=

```
NSolve[(e1 + N1) * (h2 + N2) * r1 * (1 - N1 / K1) -
(e1 + N1) * (1 - P1) * a1 * N2 + (h2 + N2) * P1 * eps1 * N2 == 0 &&
(e2 + N2) * (h1 + N1) * r2 * (1 - N2 / K2) - (e2 + N2) * (1 - P2) * a2 * N1 +
(h1 + N1) * P2 * eps2 * N1 == 0 && N1 > 0 && N2 > 0, {N1, N2}]
```

NSolve::ratnz : NSolve was unable to solve the system with inexact coefficients. The answer was obtained by solving a corresponding exact system and numericizing the result. >>

Out[158]= { {N1 → 500.966, N2 → 524.295} }

In[159]:=

```

Manipulate[ {Solve[(e1 + N1) * (h2 + N2) * r1 * (1 - N1 / K1) -
    (e1 + N1) * (1 - P1) * a1 * N2 + (h2 + N2) * P1 * eps1 * N2 == 0 &&
    (e2 + N2) * (h1 + N1) * r2 * (1 - N2 / K2) - (e2 + N2) * (1 - P2) * a2 * N1 +
    (h1 + N1) * P2 * eps2 * N1 == 0 && N1 > 0 && N2 > 0, {N1, N2}]}

, Style["parameters", Bold]
, {{K1, 500, Style["K1", Italic]}, 1,
  700, 10, ImageSize → Tiny, Appearance → "Labeled"}
, {{K2, 500, Style["K2", Italic]}, 1, 700, 10,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{r1, 1, Style["r1", Italic]}, 0, 5, 0.1,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{r2, 1, Style["r2", Italic]}, 0, 5, 0.1,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{a1, 0.1, Style["a1", Italic]}, 0, 10, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{a2, 0.1, Style["a2", Italic]}, 0, 10, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{eps1, 0.1, Style["eps1", Italic]}, 0, 10, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{eps2, 0.1, Style["eps2", Italic]}, 0, 10, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{P1, 0.5, Style["P1", Italic]}, 0, 1, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}
, {{P2, 0.5, Style["P2", Italic]}, 0, 1, 0.01,
  ImageSize → Tiny, Appearance → "Labeled"}}
, TrackedSymbols → True
, ControlPlacement → Left
, SynchronousUpdating → True]

```

Out[159]=

