Bringing ecosystem services close to the farmers: A case of Pollination

Mwari MUSYOKI and Dr Muo KASINA
Outline of presentation

1. Defining ecosystem services
2. Pollination as ecosystem service
3. Pollination-farmer interface
4. Value of pollination in Kenyan Agriculture
5. Status of pollination service provision in agricultural land of Kenya
6. Pollinator management
7. Acknowledgement
1. Ecosystem service

• Defined as benefits (goods and services) to humans that are derived from the ecosystems

• There are four categories of ecosystem services based on their functions
  – Provisioning: e.g. food, water
  – Regulatory: e.g. biocontrol
  – Support: nutrient cycling, pollination
  – Cultural: e.g. spiritual and recreation
2. Pollination as ecosystem service

• **Pollination:** Transfer of pollen grains from anther to stigma

• The process may take place in the
  – Same flowers
  – Flowers in the same plant
  – Flowers in different plants of same species

• **Effective pollination** is whereby the following conditions are met
  – Pollen is carried and deposited on the same plant species
  – Pollen carried is mature and thus can germinate once deposited
  – Stigma receiving the pollen must be receptive (ready)
• Pollination is a precursor to fertilization of flowers
  – It’s the process of moving the pollen (containing male gametes) from anthers and depositing them at the stigma
  – This is followed by pollen germination
  – Finally the male gametes fertilize the ovules from where the seeds and fruits start to grow

• Pollination occurs for many flowering plants, crops and non crops

• Pollination can be mediated by
  – Wind
  – Water
  – Gravity
  – Animals: over 85% being insects and of these over 90% being bees
• Animal mediated pollination is the most challenging
  – Highly dependent on presence of sufficient number of the pollen vector
  – There is high specialization due to co-evolution of plants and animals
  – Diversity is therefore more important, coupled with density of the efficient pollinator

• Current discussion about pollination management is based on the animal-mediated pollination
  – The evidence of reducing number of effective pollinators
  – Evidence of increasing yield losses
  – Evidence of effects on food nutrition as a result of declining pollination provision
Examples of pollinating insects
3. Pollination-farmer interface

• Pollination is not only important for general plant reproduction success, without which we may have reduced tree and non tree development
  – BUT it is equally important for crop yields

• Farmers are highly reliant on effective pollination to deliver best yields
  – In many instances pollination is not factored in crop management practices in Kenya
  – There is less information about pollination information
  – Even when information is there, farmers assume pollination will just happen

• Thus taking steps to secure crop yields is very essential
  – Through pollination management
Examples of pollination products
Indication of pollination deficiency
4. Value of pollination in Kenyan Agriculture

• Two levels can be compared
  – At farmer level
  – At national level

4.1 Farmer level
  – Yields are directly as a result of pollination management

• Crop dependence on pollination can be characterized as:
  – Essential: 95% dependence (yield decrease: 90-100%)
  – Great: 65% dependence (yield decrease: 40-<90%)
  – Modest: 25% dependence (yield decrease: 10-<40%)
  – Little: 5% dependence (yield decrease: >0-<10%)
  – 0% dependence: No yield decrease
Income scenarios confronting farmers

- No fruit without pollination
- Quality fruits if pollinated
- Without honey bees, it is a risk to grow
- Carpenter bees
Recent evidence at farm level

• Common beans, cowpeas, greengrams and other pulses
  – 40% net benefit from pollination by carpenter bees
  – Increased protein content when sufficiently pollinated

• Sunflower
  – Almost 60% net benefit both in weight and oil content
  – Honey bees and other wild bees are very important

• Cucurbitas
  – 100% yields depended on honey bee pollination
• Tomatoes and other solanacea plants
  – 25% net benefit under field conditions
  – Up to 60% net benefit for capsicum
  – Cannot sustain yields under greenhouse conditions if not provided with pollinators
  – Large stingless bees such as Meliponula spp are essential and wild bees such as halictids

• Passion fruits
  – Low quality fruits if not provided with carpenter bees for pollination
  – Net benefit of 40% as a result of sufficient pollination

• **KEY MESSAGE**
  – Farmers are loosing as the pollinators disappear from their gardens
4.2 Value of pollination at national level

Few questions:

✦ How much is the country likely to loose with declining pollination provision?

✦ How much will declining pollination service cost to consumers?

Data used for assessment

✦ 2005 annual report and FAOSTAT based on crop yields and prevailing prices
Results outlook

55% of crops examined do not depend on insect pollinators for yields
However, crops requiring pollinators contribute more to the economy (i.e. 65\% of the agriculture GDP)

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Annual value, KES</th>
<th>Pollination requirement</th>
<th>Contribution to the total value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fruits</td>
<td>117,257,415,928.29</td>
<td>Yes</td>
<td>28.5</td>
</tr>
<tr>
<td>Vegetables</td>
<td>97,467,930,444.5</td>
<td>Yes</td>
<td>23.7</td>
</tr>
<tr>
<td>Cereals</td>
<td>76,411,683,789.87</td>
<td>No</td>
<td>18.6</td>
</tr>
<tr>
<td>Roots and Tubers</td>
<td>46,895,231,226.65</td>
<td>No</td>
<td>11.4</td>
</tr>
<tr>
<td>Stimulant crops</td>
<td>43,985,449,987.31</td>
<td>Yes</td>
<td>10.7</td>
</tr>
<tr>
<td>Pulse</td>
<td>11,765,112,779.13</td>
<td>Yes</td>
<td>2.9</td>
</tr>
<tr>
<td>Sugar crops</td>
<td>9,105,440,302.18</td>
<td>No</td>
<td>2.2</td>
</tr>
<tr>
<td>Treenuts</td>
<td>3,846,646,840.29</td>
<td>Yes</td>
<td>0.9</td>
</tr>
<tr>
<td>Oil crops</td>
<td>3,226,551,620.61</td>
<td>Yes</td>
<td>0.8</td>
</tr>
<tr>
<td>Spices</td>
<td>1,861,918,057.27</td>
<td>Yes</td>
<td>0.5</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>411,823,380,976.1</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Expected economic impact

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Pollination value (KES)</th>
<th>Pollination dependency</th>
<th>Consumer surplus with elasticity’s of -0.8</th>
<th>Consumer surplus with elasticity’s of -1.2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cereals</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Fruits</td>
<td>29,900,641,061.71</td>
<td>25.50%</td>
<td>13,428,767,543</td>
<td>10,974,795,835</td>
</tr>
<tr>
<td>Oilcrops</td>
<td>591,534,463.78</td>
<td>18.33%</td>
<td>624,973,677</td>
<td>593,442,721</td>
</tr>
<tr>
<td>Pulse</td>
<td>147,063,909.74</td>
<td>1.25%</td>
<td>722,512,984</td>
<td>715,138,859</td>
</tr>
<tr>
<td>Roots and Tubers</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Spices</td>
<td>265,988,293.90</td>
<td>14.29%</td>
<td>67,677,813</td>
<td>42,210,669</td>
</tr>
<tr>
<td>Stimulant crops</td>
<td>5,498,181,248.41</td>
<td>12.50%</td>
<td>1,579,739,907</td>
<td>1,491,412,717</td>
</tr>
<tr>
<td>Sugar crops</td>
<td>0</td>
<td>0.00%</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Treenuts</td>
<td>897,550,929.40</td>
<td>23.33%</td>
<td>584,910,188</td>
<td>474,342,722</td>
</tr>
<tr>
<td>Vegetables</td>
<td>16,650,771,450.94</td>
<td>17.08%</td>
<td>3,278,770,126</td>
<td>2,446,623,089</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>53,951,731,357.88</strong></td>
<td><strong>11.23%</strong></td>
<td><strong>20,287,352,237.2</strong></td>
<td><strong>16,737,966,610.8</strong></td>
</tr>
</tbody>
</table>
Explanation of the table

• Consumers of the pollination dependent crops will pay more if pollination is not sufficiently provided

• A 11% monetary loss, more than 20 billion, is not little amount of money
  – Efforts to reduce any loss should be adopted
  – This includes conservation and protection of pollinators by farmers, NOT at the conservation parks

• While at farm level losses don’t seem very big, the national outlook is quite high
  – Thus farmer loss contributes to the country loss
Global pollination scenarios

Happening in the USA: selling pollination service

Honey bee colonies for pollination contracts
Common practice in Holland to guarantee tomato yields

Bumble bees pollinating tomato
Some pollination value estimates across the globe

- **In America**
  - 1980: USD 19 billion (about KES 1.9 trillion)
  - 1985, USD 9.3 billion per year (about KES 930 billion)
  - 1986, USD 1.6 billion (about KES 160 billion) to 5.7 billion (about KES 570 billion)
  - 1996-98, USD 14.6 billion (about KES 1.5 trillion)

- **In UK**
  - 1997: UKP 690 million (about KES 96.6 billion)
  - 2010: UKP 603 million (about KES 84.4 billion)

- **Global**
  - 1997, USD 117 billion per year (about KES 11.7 trillion)
  - 2005, USD 215 billion (about KES 21.5 trillion)
  - 2009, Euro 153 billion (about KES 17 trillion)
5. Status of pollination provision in farmlands

- In Kenya mainly feral pollination, unmanaged
- Few large growers are keeping colonies of honey bees to provide pollination services
  - However, they do not manage other pollinators
- Few bees being recorded on farmlands
  - Farmers cannot hear same bee sounds as they used to
- Non honey making bees not as many as they used to be
- Honey bees mainly dominating yet they are not effective for pollination all crops
• Majority of farmers do not differentiate wild bees from crop pests
• Farmers do not link bee presence in their crops with crop yields they harvest
• Farmers perceive bees as only honey bees
  – These are known only for provision of honey
Land use and land management effects

- Land intensification - Clearance of habitats for agriculture
- Increased land under monoculture
- Increased use of pesticides
- Reduced reliance on traditional knowledge of crop husbandry, including pest management
- Hedgerows of similar architecture
6. Pollinator management

1) Protecting areas for dwelling of bees and other pollinators
Blocking of nests
• Kills bees locked inside
• Exposes bees to grave danger
• Disorientates returning bees

• And generally, it is a torture
  • To bees
  • To farmer: no yields
  • To public: pay more for something that could have been paid cheaply
2) Protecting pollinator food resources

- Source of Nectar and pollen
3) Adopting farm practices friendly to bees

- Conservation agriculture; minimum tillage
- Use of **hedgerows** comprising of trees, herbs and shrubs
- Leaving small **patches** and setting small portions of lands free
- Less pesticides use
- Leaving **dead wood** around farmlands for nesting
Hedgerows within farmlands/pastureland
4) Mainstreaming pollination in farming

• Extension message laced with pollination message
• Good agricultural practices defined by the aspects of pollinators, among others
• Farmer support materials such as pamphlets, brochures
• Introducing friendly spots in urban areas to protect urban pollinators
• Securing public spots within farming communities where land is set aside for beneficials and pollinators
  – Creating streams of hope for communities from ecosystems
• Improving relationship of farmers with nature
  – Educating and creating awareness on likely gains and protection from nature
  – Building strong willed community members for nature
• Enhanced land use and land management policies that support protection of pollinators within agricultural community e.g.
  – Planned management of *hedgerows, patches* and *land set-aside* in the farm land
  – Legislation on growing various crops under a *certain system* e.g. in Brazil, and passion fruits
  – *Reduced tilling* of land in order to protect the ground nesting bees
  – Practicing various *cropping systems* to optimize pollination in their farms
  – Managing pesticides usage in farms
  – *Managing cutting down of trees* within farmlands
• Capacity building Kenyans to respond to nature
  – Supporting environmental campaigns
  – Establishing groups for environment
    • Youth for environment
    • Women for environment
    • Wakulima for environment etc
  – Reaching out to primary, secondary schools and colleges
    • Revive and promote agriculture clubs for environment
    • Support environmental debates
  – Support postgraduate projects on agroecology
    • Partner with researchers and universities

• Promote agroecological farming in Kenya
  – The next frontier in securing food and nutrition for our people
7. Acknowledgement

• Total Kenya for invitation to participate and present work on pollination
• Participants
• KALRO for support
• Partners
  – MOALF
  – FAO/GEF/UNEP
  – NMK
  – Nature Kenya
  – Kenyatta University
• Farmers
Thank you