**Step Three Resource: “**Biotechnology and its applications for benefit of mankind.” (article title) by Ashwani Kumar

"Sustainable agriculture" is as  articulated in the 1990"Farm Bill" Food, Agriculture, Conservation, and Trade Act of 1990,P.L. 101-624, Title XVI, Subtitle A, Section 1603) sustainable agriculture means "an integrated system of plant and animal production practices having a site-specific application that will, over the long term: (A) **satisfy human food and fiber needs**; (B) **enhance environmental quality** and the natural resource base upon which the agricultural economy depends; (C) make the most efficient use of **non renewable resources** and on-farm resources and integrate,where appropriate, natural biological cycles and controls; (D) sustain theeconomic viability of farm operations; and (E) **enhance the quality of life for farmers and society as a whole."**

 How far biotechnology can help achieve these goals :

**Benefits of biotechnology**

It is  a precise process in which scientific techniques

It is a technique  to develop useful and beneficial plants.

It improves process of  traditional plant breeding

* Five priority areas have been  identified:
* A- **Food industries.** Production of single-cell protein, Spirulina, enzymes and solid-state fermentations.
* B- **Increase and improvement of agricultural production**.
* C- **Production of pharmaceuticals  ;** the extraction of biologically active plant substances.
* D- **Immunology:**Production of vaccines and monoclonal antibodies.
* **Virology** : Cultivation of virus for vaccineproduction, also used to study there infectious cycle.
* **Genetic Engineering** :  Production of commercial proteins, large scale    production of viruses for use in vaccine production e.g. polio, rabies, chicken pox,hepatitis B&measles

• **Gene therapy**: Cells having a functional gene canbe replaced to cells which are having non-functional gene

* E-**Use and recycling of agricultural and industrial wastes**and by-products for the production of ethanol, acetone butanol and methane

 Biotechnology has the potential to assist farmers in reducing on-**farm chemical inputs** and**produce value-added commodities.**However  there are concerns about the use of biotechnology in agricultural systems including the possibility that it may lead to greater farmer dependence on the providers of the new technology. This is open for debate.

**Limitations of Conventional Breeding**

(1) F1 hybrid produced is of intermediate quality

(2) Extreme heterozygosity and pronounced inbreeding depression in plant species                           (3)  Screening of new selections is  tedious and time consuming

**How does Plant Biotechnology help ?**

* Biotechnology is a  frontline technologies today being developed and used to understand and manipulate biological molecules for applications in medical, agricultural, industrial and environmental sectors of the national economy.
* Recent advances in biotechnology provide good opportunities for immediate benefits to developing countries.
* **The innovations made in biotechnology applications include :**

  a.  development of **micro-propagation systems** for many plant species and of new plant varieties with highly desirable characteristics.

  b-M**anipulation of genetic material** and its cloning into other organisms.

  c-  Production of **genetically engineered plants** that are resistant to \_insects viruses,  and herbicides.

d    **Fermentation technology** producing many human and animal health products, as well as food and feed ingredients.

E- Treatment and **utilization of liquid and solid wastes**.

These developments could have wide applications in agricultural production and environmental protection

* The main challenges facing the developing  countries are related to **food supply** and **conservation of resources**.
* Biotechnological approach can help in better utilization of resources:

   a-  Nutrient availability, uptake and nutrient cycle  and increasing soil fertility through  regulating biological activities

   b- i**ncreasing food production** through genetically improved plants.

* In 1982, the production of dates in the Near Eastern and North African countries accounted for about 73 percent of total world date production (1.9 million tonnes).
* Vegetative micropropagation through tissue culture is therefore a promising technique for multiplying elite, high-yielding and disease-resistant trees.
* The results obtained in Saudi Arabia as well as in Morocco, Algeria and Tunisia have shown that in vitro micropropagation can be very successful.
* However, future research is needed to overcome the difficulties related to early flowering and lack of uniformity of the cloned plants.

   c- \_**Bioremediation biological waste water treatment**

   d-    and **Bioconversion of waste for food and feed ingredients**.

**Developing renewable energy sources and waste recycling is possible using biotechnology techniques  and techniques in making:**

**Agricultural and forest residues generated in some countries** (Morocco, Turkey, Yemen, Iraq and the Syrian Arab Republic) are considered renewable resources that can be utilized by biotechnological means for the production of food, feed, fertilizers and fuel.  Biotechnology can improve the existing processes and develop new metabolic pathways for improved products or production levels.

**The majority of these countries have established traditional fermentation industries**,e.g The United Arab Emirates, Saudi Arabia, Qatar, Oman, Kuwait, the Syrian Arab Republic and Egypt.

* There are various sources of **raw materials for fermentation** in developing countries .
* Huge quantities of hydrocarbons and methanol are found in oil-producing countries,
* **Carbohydrate by-products (molasses) and lignocellulose waste (cardboard, paper)**are found in most countries.
* **Baker's yeast production** (The Syrian Arab Republic, Lebanon, Iraq and Egypt);
* **Methanol and acetic acid production** (Iraq, the Syrian Arab Republic, Lebanon and Egypt); and D- acetone,butanol and citric acid (Egypt).

 Fermented dairy products' plants have been established in all countries and biotechnology offers enormous scope for improvement.

* Biotechnology can offer better technologies for most of the developing  countries and  biological treatment plants for sanitary waste water can help utilize treated waste water for landscaping and agriculture.