Agricultural technology transfer society (ATTS) perspectives for technology transfer

Vision*: attainment of food security in Sudan through availing appropriate technologies*

Mission: *Improve research and development (R&D) options to reduce rural poverty and vulnerability.*

Goals

*1- **Develop and promote** affordable and sustainable soil, water, crop and nutrient management options and integrated approaches to watershed management;*
*2. **Identify and promote** options for systems diversification (high-value crops, trees and livestock) to improve rural livelihood security;*
*3. **Enhance capacity** of R&D partners*

Currently there are more than 800 million hungry people in the world. One in three people worldwide, mostly women and children, suffer from diseases associated with malnutrition and the lack of vital nutrients. *ATTS contributes to improved food security, livelihood resilience and poverty reduction through Integrated Genetic and Natural Resource Management and people-oriented, partnership-based research. The research outputs empower the poor to mitigate market and non-market generated shocks, inequalities and risks.*
In order to address ATTS's vision and to significantly contribute to the MDGs, particularly those addressing poverty, hunger, health, gender and environmental sustainability, there is a need to further enhance not only crop productivity and production, but also the quality of food, feed and fodder and where possible, to reduce the cost of production.

Adopted technologies

WATER TECHNOLOGIES

Some technologies suitable for smallholders include:

- ***Low-cost drip irrigation****: Decreases in water use range from 40 to 80 per cent compared to with traditional surface irrigation systems.*
- ***Bagging water for irrigation. Low-cost plastic*** *water tanks used to store runoff water collected during the rainy season from small catchments or water from perennial wells or streams for use in the dry season.*
- ***Groundwater extraction****: Hand pumps; treadle pumps; wells; boreholes; open galleries.*
- ***Water harvesting****: Contour bundling; check dams; gully plugs; dykes; rooftop; cisterns; surface ponds; fog harvesting*
- ***Water storage:*** *Dams and reservoirs; wetlands; aquifers; ponds and tanks*
- ***Soil water conservation:*** *Zero-tillage; crop residue management; crop rotation; compost; green manure; mulches; clays*

BIOLOGICAL TECHNOLOGY

*If the original planting material happens to be of poor quality, it will result in poor yields and generate losses to the farmer. A great deal of plant breeding has been undertaken with some crops to meet a wide range of quality attributes. Dry matter and taste attributes as well as ripening times and rates and **post-harvest** longevity have also influenced the breeding process. Through restoring the health, a practice known as 'integrated soil fertility management' which combines the use of organic and inorganic nutrients with mineral nutrients to increase crop yields. The approach focuses on the timing and placing of inputs to maximize nutrient-use efficiency.*

Beneficial biological organisms

Soil microorganisms can help plants to absorb nutrients. The utility of these microorganisms can be enhanced by selecting the most efficient, culturing them and adding them to soils directly or through seeds. The cultured microorganisms packed in carrier material for easy application in the field are called bio-fertilizers.

BIOTECHNOLOGY

a. ***Tissue culture and micro-propagation***

The plant tissue culture technique requires a sterile workplace, a nursery/greenhouse, and trained manpower. It is an important technology for the production of disease-free, high quality planting material and the rapid production of many uniform plants.

b. ***The potential of GM crops and their adoption***

*Genetically modified (GM) crops are often held up as the solution to yield deficits as well as offering other benefits such as improved appearance, taste and nutritional quality, drought tolerance, and insect and disease resistance. The most common trait being introduced into GM crops is herbicide tolerance; this trait is now found in about 80 per cent of all GM crops planted worldwide. Sorghum is food crop from the grass family have its genome fully sequenced. Combining the new knowledge on the sorghum genome sequence with expertise on molecular-marker assisted crop selection and breeding could result in the development of improved sorghum varieties and hybrids with improved **drought tolerance or disease resistance.***

c. ***Developing disease-resistant crops***

DEVELOPING DISEASE-RESISTANT CROPS

Increasing disease resistance in crops is another means to increase plant yields, as disease can seriously limit productivity. Through genetic breeding, the incorporation of resistance genes into high-yielding varieties can be replaced by low varieties

HERBICIDES AND PESTICIDES

The inability to control weeds is an important factor in stifling crop growth and yields. Farmers lose 25 to 100 per cent of their crop yields to competition from weeds. Proponents of organic farming are encouraging the use of natural, non-

toxic and environmentally friendly forms of pest control. Unfortunately, very few herbicide alternatives have been developed, and fewer still match the productivity and economic advantages of chemical herbicides, thereby resulting in a competitive disadvantage for organic farmers. Nonetheless, organic produce can yield higher incomes as organic food often commands a price premium.

POST-HARVEST TECHNOLOGIES

Reducing post-harvest losses and enhancing shelf life, Adding value for perishable products. Crop losses could be reduced through the application of readily available technologies and input management using minimal additional resources. Developing post-harvest technologies and innovation therefore provides considerable opportunities for food security, trade and economic growth. Overcoming the perishability of the crops, enhancing their nutritional value and adding additional economic value locally through agricultural processing is one important way to increasing food security.

ECOLOGICAL APPROACH

The ecological zone approach is based on the specific ecological zone where farming takes place, and aims to increase the choices and options available to farmers and enhance their ability to adapt to challenges such as erratic rainfall and climate change. In this regard, each ecological zone dictates a range of possible farming systems. Technologies can be chosen according to their adaptability to the type of agro-ecological zone.

INTEGRATING FARMERS INTO A NATIONAL PLANT GENETIC RESOURCES SYSTEM

Farmers are likely to know the nature and extent of local crop resources better than anyone through their daily interactions with the diversity in their fields. Incorporation of farmers into the national genetic resources system can help create productive partnerships for all involved. This integration can happen in several ways, including:

- *Seeing farmers as partners in the maintenance of selected germplasm*
- *Establishing a national dialogue on biodiversity conservation, sustainable use and equitable benefit-sharing between farmers, gene-banks and other partners*
- *Assisting the exchange of information with and among farmers from different sites and projects*
- *Farmers visiting gene-banks or seeing demonstrations by gene banks*
- *Developing systems to make gene bank material more easily accessible to farmers.*

SEED SYSTEMS AND DIVERSITY MAINTENANCE

On farm biodiversity management programmes that support strong seed supply systems can foster increased use of diversity while fulfilling certain types of farmer seed demand. Strong seed supply systems enable farmers to maintain a high level of diversity over time, despite losses of seed stock, bottlenecks, and other regular or unanticipated losses of crops genetic diversity.

Community seed banks

In many developing countries, farmers rely on informal seed systems based on local growers retention of seed from previous harvests, storage, treatment and exchange of this seed within and between communities. The informal seed sector is typically based on indigenous structures for information flow and exchange of seed. Seed banks managed within this local seed system operate on a small scale at the community level with few resources.

These community seed banks and the institutions that support them are extremely important in the preservation of local varieties and for agricultural production. Much could be gained from learning more about these seed banks and working with communities to improve them. In spite of this, informal seed banks have until now received little attention or support from the scientific community or the state.

Field gene banks

The conservation of germplasm in field genebanks involves the collecting of materials and planting in the orchard or field in another location. Field genebanks have traditionally been used for perennial plants, including:

- *species producing recalcitrant seeds;*
- *species producing little or no seeds;*
- *species that are preferably stored as clonal material; and*
- *species that have a long life cycle to generate breeding and/or planting material.*

Field gene banks are commonly used for such species as cocoa, rubber, coconut, coffee, sugarcane, banana, tuber crops, tropical and temperate fruits, vegetatively propagated crops, such as wild onion and garlic, and forage grasses.

BIOFORTIFICATION OF STAPLE FOODS

Biofortification, is a process that uses ***plant breeding to increase the density of minerals, vitamins, and other nutrients and compounds in food staples eaten widely by the poor.*** *Biofortification offers a rural-based intervention that, by design, initially reaches the more remote populations that comprise a majority of the undernourished in many rural areas, and then penetrates to urban populations as production surpluses are marketed.*

*In order to reduce undernutrition and have a measurable positive impact on human nutrition, **activities such as** breeding, improved agronomic practices, will be developed to obtain and distribute varieties of food staples with high nutritive content (wheat, maize, groundnut, sorghum).*

FORAGE DIVERSITY FOR DIFFERENT LIVESTOCK PRODUCTION SYSTEMS

*Poor-quality feed and fluctuating feed supplies are the biggest constraints to increasing livestock productivity, **identify genotypes that have potential as livestock feed is important. Forage diversity could be coordinated with plant genetic resources activities.***

IMPROVING ANIMAL GENETIC RESOURCES CHARACTERIZATION

- *Enhance the utilization, management, improvement and conservation of animal genetic resources to contribute to the improvement of livelihoods of resource poor livestock keepers.*
- *Develop animal genetic resource tools and information systems as decision aids for conservation and use of animal genetic resources.*

LINKING WILD AND CULTIVATED SYSTEMS

Managing agro-ecosytems and the biodiversity is essential for human health and nutrition and for the continued availability of food and other agricultural products.

On-farm conservation and use also serves to empower farmers to control the genetic resources in their fields. On-farm genetic resource management recognizes farmers and communities as the curators of local biodiversity and the traditional knowledge to which it is linked. In turn, farmers are more likely to reap any benefits that arise from the genetic material they are managing. On farm biodiversity management programmes can serve to increase out knowledge about the links between wild crop species and cultivate ones.

NEGLECTED AND UNDERUTILIZED SPECIES

These neglected and underutilized species play a crucial role in the food security, income generation and food culture of the rural poor. Lack of attention has meant that their potential value is under-estimated and under-exploited. It also places them in danger of continued genetic erosion and disappearance. This would further restrict development options for the poor.

They can improve nutrition levels

Many neglected and underutilized species are nutritionally rich and are adapted to low input agriculture. The erosion of these species can have immediate consequences on the nutritional status and food security of the poor. Wild, semi-domesticated or *fully cultivated, these species are important for the well being of local communities. Their enhanced use can bring about better nutrition and fight hidden hunger.*

They can improve incomes

Surveys in Vietnam reveal that income generated by home gardens in that country is comparatively better in those gardens where there is a higher number of food crops grown by farmers. Yet, a great part of the species cultivated in these home gardens belongs to the category of underutilized and neglected crops.

Growing market opportunities for these species may generate additional income to those poor farmers in less favored environments where these crops have comparative advantages over staples or major crops.

They can improve environmental health

Climate change and the degradation of land and water resources have led to a growing interest for crops and species that are adapted to difficult environments. Many neglected and underutilized species are recorded to occur wild or under cultivation in these areas. In many instances these species are the only crops that can cope with such harsh environments unfit for other crops, where they can provide sustainable productions.

DIVERSITY WITHIN TREE SPECIES

Forest tree species are typically long-lived and have developed natural mechanisms to maintain high levels of genetic variation within species. From a biological viewpoint, genetic variation is needed to ensure present-day and future adaptability of species as well as their continued evolution. From a human and development perspective, variation is also vital to maintain options and potential for genetic improvement to meet changing end user requirements and dynamically evolving environmental conditions. Sustaining progress in rural development, and enhanced livelihoods for the poor, will require improved access and availability to diverse germplasm of indigenous and introduced tree species.

WARNING SYSTEM

It important to provide timely climate early warning information to enable farmers cope with various risks associated with extreme climate variability and change for poverty alleviation, environment management and sustainable development. It is also important to maintain quality controlled databases and information systems required for risk/vulnerability assessment, mapping and general support to the national/ regional climate risk reduction strategies.