2nd International Seminar

on

Land Resources and Land Use Options –
Challenges for Food Security and Sustainable Development

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International Foundation for Sustainable Development in Africa and Asia (IFSDAA)

in collaboration with

African Asian Studies Promotion Association (AASF),
Goettingen, Germany

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Contents

About the International Seminar and IFSDAA

On a global scale, land resources are becoming increasingly scarce. The quality of resources such as soil, water, plants and animals is decreasing, mostly as a result of poor management. Estimates from UNEP say, that about 2000 million ha of soil, equivalent to 15 per cent of the Earth's land area (an area larger than the United States and Mexico combined), having been degraded through human activities. A total of 305 million ha of soils ranged between 'strongly degraded' (296 million ha) and 'extremely degraded' (9 million ha, of which more than 5 million ha are in Africa). In the more severely affected regions land degradation threatens the economic and physical survival of the human population. But also the industrialized nations of the north face severe problems with land resources, its quality and availability. According to a recent report of Federal Environment Agency (Umweltbundesamt) published in 2008, growth in traffic areas, roads and new settlements affect productive agricultural areas resulting in a loss of up to 130 ha per day in some central European countries. This loss in area threatens agricultural production and subsequently future global food security.

Ensuring food security requires a multifaceted and multidisciplinary approach. In order to reduce poverty in many African and Asian countries climatic, ecological, and financial conditions in the framework of sustainability need to be considered. Because of soil degradation, unforeseeable climatic conditions, a lack of agricultural equipment and missing appropriate production technology based on elements of sustainability science, food production is lagging behind the annual population growth. Even more, the effect of growing energy-crops for fuel production like alcohol and bio-diesel leading to increased food prices will be the driver for land use conflicts. The increasing and fluctuating price of crude oil in the world market will deepen the impoverishment of many countries in Africa and Asia leading to political instability and migration of people in search of food and survival. These aspects have technological, environmental and economical relevance and global concerns, particularly for countries in Africa and Asia.

The main objective of this International Seminar is to deliberate on issues related to sustainable crop production for food and biomass energy, rural resource management and on enterprises for sustainable growth in agriculture and overall agrarian prosperity for food, biomass energy and livelihood security.

The recently established International Foundation for Sustainable Development in Africa and Asia (IFSDAA) is an initiative to complement the efforts of umbrella organisations like African Asian Studies Promotion Association (AASF e.V.), universities and research organisations in Europe, Africa and Asia for promotion of technology-transfer and participatory exchange of knowledge and experience.

The main objectives of IFSDAA are:

1. To provide a common international platform for the exchange of scientific information, international conferences, workshops, group discussions on sustainable agriculture, food security, renewable energy, global climate change and sustainable development etc. and other topical local and global issues.
2. To carry out research and development work on sustainable agriculture for food, bio-energy, rural bio-resources, livelihood and sustainable development on behalf of government/non-government agencies in developing countries.
3. To honour scientists / academics globally and in particular in Africa and Asia for their outstanding contribution in the area of sustainable agriculture, food security, resource management and sustainable development.

4. To publish periodically a newsletter on sustainable agriculture for food, bio-energy, livelihood security and sustainable development.

Issues of food, energy and livelihood are growing concerns of governments and the civil society in developing and developed countries. Food and energy security is determined by the availability of food and energy resources as well as people's access to them. They are closely interlinked with livelihood and economic power. In order to feed the ever increasing population of the world there is an urgent need to double crop production by the year 2050. This goal has to be achieved despite shrinking land, water and other natural resources.

To meet the UN Millennium Sustainable Development Goal of reducing the number of hungry people to half from its current number of about 825 million by 2015, there is a need to enhance crop production and crop productivity, especially in developing countries. However, climatic change, particularly global warming and green house gas emissions, further aggravate the problems of crop production and cause damage to the production environment. In addition, in order to cope with the emerging threats of dwindling earth oil sources, there is a need for improved technologies for the production of biomass-energy. This would necessitate identifying and cultivating fast growing plants with high hydrocarbon content, adapted to tropical as well as temperate environs, and efficient bio-fuel production technologies.

It is therefore essential to concentrate on research and development efforts towards sustainable agriculture, natural resource management for food and biomass energy. This would ensure adequate agri-based employment and livelihood opportunities and thus contribute to the alleviation of poverty. Globalization and trade liberalization, in the face of inequities of the resource base among different states and inadequate social infrastructure, call for policy reforms, international dialogue and joint efforts for sustainable development, especially in Africa and Asia.

The African Asian Studies Promotion Association (AASF) in Goettingen has for several decades, through its programme of reintegration of returnees from German Universities to their home countries, encouraged scientists and development functionaries from Africa and Asia to play an important role in this endeavour. It has been supported by the World University Service (WUS).

IFSDAA's aims are designed as an extension of the activities of AASF and its goals towards sustainable development through the concept of **global scouts.** It should also be mentioned that AASF has a students' hostel in Goettingen, the Mahatma Gandhi House, in which 120 students from Asia, Africa and Germany closely live together.

Last but not least, the geographical central location of Goettingen is an important factor to develop this town as a meeting point for scholars coming to Germany, allowing virtual communication to turn into a real world by enabling accommodation and hospitality and organizing seminars in the fields of sustainable development. Goettingen is a town renowned for its research infrastructure and expertise available at the Georg August University and other scientific institutions and is a centre of excellent studies for the international community.

Dr. K. Wolde-Giorgis
Executive Secretary, IFSDAA

Prof. Dr. C. Kaetsch
Chairman, International Seminar

IMPACT OF ETHYLENE-DIAMINE RESISTANT MUTANTS OF *AZOSPIRILLUM LIPOFERUM* (*LACZ*+) MARKED ON CROP PRODUCTIVITY OF WHEAT

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Abstract

High, low and medium ammonia excreting derepressed ethylene diamine resistant mutants of *lac z*+ marked strain of *A. lipoferum* have been isolated. High ammonia excreting mutants showed higher acetylene reducing activity (ARA) thus indicating that these properties are related to each other. However, there was no relationship between indole acetic production and NH_4^+ excretion or Acetylene reduction activity (ARA).

Acetylene reduction activity in parent strain was repressed in the presence of NH_4 Cl/KNO_3 and up to 70% even in the presence of sodium glutamate. However, the acetylene reducing activity in high NH_4^+ excreting mutants was not repressed in the presence of sodium glutamate or NH_4Cl indicating that these are derepressed mutants.

All the mutants were tested for their effect on growth and ammonia excretion on different sugars and N sources etc. Mutants grew poorly on glucose, fructose and sucrose but maximum NH_4^+ excretion was found to be in the presence of glycerol as carbon and energy source. The pH remained stable. High $NH+_4$ excreting mutants excreted 3 times more ammonia than low NH_4^+ excreting mutants. Growth of the mutants was more when 20mM sodium glutamate was supplemented as compared to 10mM sodium glutamate. All the mutants irrespective of the level of NH_4^+ excretion establish themselves in the rhizosphere of wheat plant (*Triticum aestivum*) under pot house conditions. The viable count of high ammonia excreting mutants varied from 32 to $57x10^3$ cfu g^{-1} soil where as it was 41 to $51x10^3$ cfu g^{-1} soil of low ammonia excreting mutants.

The effect of high ammonia excreting mutants did not differ much with low ammonia excreting mutants after 30 days of plant growth. High ammonia excreting mutants showed their effect on shoot dry weight as plant biomass accumulation was manifold higher than uninoculated plants as well as plants inoculated with low ammonia excreting mutants. But after 90 days of plant growth, plant biomass accumulation by inoculation with high ammonia excreting mutants of *A. lipoferum* was more as compared to inoculation with low ammonia excreting mutants. Nitrogen uptake by the plant was increased 2 fold by inoculating with wild type strain. Inoculation with low ammonia excreting mutants increased nitrogen uptake by the plant from 1.8 to 2.2 mg N $plant^{-1}$. Nitrogen uptake increased to 5 times when inoculated with high ammonia excreting mutants.

STRATEGIES OF MAIZE BREEDING TO INCREASE EFFICIENCY OF LAND USE AND PHYTOMASS CONVERSION TO MITIGATE CLIMATE CHANGE

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Abstract

The impacts of climate change on agriculture may add significantly to the development challenges to ensure food security and reducing poverty. Climate change urgently needs to be assessed at the level of the household, so that poor and vulnerable people dependent on agriculture can be appropriately targeted in research and development activities whose object is poverty alleviation.

Conventionally, land has been used to meet the world's food requirements, while other sources such as oil, coal and gas have been used to meet energy and transport fuel requirements. The growing potential of biofuels appears to create a substantial opportunity for the world's farmers. With continued increases in maize yields, bioethanol can be obtained with no increase or even a decrease in global cropland area.

Can small-scale farmers and poor people in developing countries take advantage of this opportunity? A modern biofuels industry could also provide developing-country farmers with a use for crop residues like stalks and leaves, which can be converted into ethanol or electricity. Emerging new technologies that convert cellulose to energy might lead to a much higher valuation of "residues", and may in fact make "residues" history in agriculture.

Increasing maize yields per hectare should therefore become the priority; it would at the same time increase food security, improve mitigation and adaptation to climate change, help to combat deforestation and desertification, better preserve biodiversity, and ultimately also allow more bioenergy production: This would improve the food security and at the same time help to achieve the objectives of the main UN environmental conventions and of the UN Millennium Goal.

IMPROVING RURAL LIVELIHOODS WITH RAINWATER HARVESTING AND CONSERVATION ON COMMUNAL CROPLANDS IN SOUTH AFRICA: OPPORTUNITIES AND OBSTACLES

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Abstract

It is estimated that 19 million people in South Africa are rural survivalists with traditional agrarian lifestyles. Of these at least 15 million individuals are living below the poverty line. In contrast, farming contributes only 10 to 30% of the material income for rural livelihoods. Furthermore, land resources in communal areas are largely under-utilised. In some villages in the Eastern Cape and Free State province, levels of food security have increased by means of maize and vegetable production in homestead backyard gardens. In the last mentioned case this has been achieved through the technology and practice of in-field rainwater harvesting (IRWH) and conservation. This technique has been developed over fifteen years of on-station and on-farm research. It can be classified as a micro-catchment, on-farm method of water harvesting with runoff strips. Through technology exchange the application of IRWH expanded to more than 1,000 households in 42 rural villages around Thaba Nchu.

Large areas of croplands surrounding these villages are currently lying fallow and indications are that this land has not been productively cultivated for the last 25 years or more. There are clearly opportunities for up-scaling of IRWH from household food gardens to communal croplands. Results of research station experiments demonstrate that e.g. maize yields increased by up to 50%, compared with conventional production techniques. Innovative procedures have been developed and tested to identify suitable soils for rainwater harvesting. Through modelling the minimum area of farmland has been determined to meet the food security needs, expressed as either income or caloric requirement. It has also been shown that IRWH is viable in terms of conservation of soil and water resources, reduction of risk, social acceptability and economic feasibility. However, delineating suitable soils and calculating sizes of land holdings is only part of the solution to improve water productivity and rural livelihoods. Surveys in the area have shown that low levels of education are found amongst household members and that widespread poverty exists. Although the expectation is that exploitation of this land can enable households to produce enough staple grain crops for own consumption and also earn cash income with sale of surpluses, various obstacles have to be overcome.

The current state of land use at Thaba Nchu is the result of a history of conflicts over legitimate rights and economic means to earn livelihoods. As for the whole of South Africa, a process of land reform is under way which involves restitution of forced dispossessions and obtaining tenure security because of past discriminatory practices. The contention is therefore that communal croplands will only be accessed sustainably with secure land tenure arrangements. A pilot project to develop a land register of holdings by households on the communal croplands has confirmed the near collapse of the land tenure system. After consultation a participatory process has started to formulate rules that explicitly define the land holding and ensure exclusive use of the land for cultivation. Various formal groups have been established to ensure enforcement of rules and enable transfer of use rights by means

of share-cropping or leases between those who are interested and not interested to farm. Successful up-scaling of IRWH will again require demonstration plots to change unrealistic perceptions regarding prospects of conventional tillage. Farmers, who are mostly women, must also receive skills training and have aspirations to improve livelihoods through more productive farming activities. The available guide for farmer trainers and facilitators should be implemented for practical skills development to the benefit of women and revitalisation of rain-fed farming. Further applied research is also being undertaken to investigate appropriate marketing channels of food crops, financing of production inputs and support services of extension which have to be provided to farmers.

ANAEROBIC DIGESTION OF ANIMAL WASTE

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Abstract

Biomass is increasingly being utilized as an energy source throughout the world. Several modern technologies have been developed that convert biomass to bioenergy. Anaerobic digestion is a mature energy technology for converting biomass to biogas, which is a renewable primary energy source. There are huge biomass resources in Jordan that have good potential for biogas production by anaerobic digestion.
However, anaerobic digestion is not being optimally used as a biomass conversion technology in the country.

Anaerobic digestion of animal manure offers several environmental, agricultural and socio economic benefits throughout improved fertilizer quality of manure, considerable reduction of odors and inactivation of pathogens and last but not least production of biogas production, as clean, renewable fuel, for multiple utilizations.

The optimization of biogas production in Jordan cannot be viewed as an option only, but also as a viable very important to improve the supply of renewable energy in the country. The challenge for Jordan is to optimize the use of this technology as part of a strategy for sustainable energy supply in the country. Biogas is a robust fuel that can be used for all applications designed for natural gas.

According to the 2009 statistics there are 73,000 cows in Jordan, which makes about 150,000 kg of dung daily, with a roughly calculation the biogas produced daily can be approximately (22,000 m^3/day) that means (8,000,000 m^3/year), not to forget the fertilizer that we can get.

From the experiments it can be seen that temperature and number of cows represent the utmost parameters in the gas production. Also it is found that as the number of cows increases the biomass production increases which will increase the digester size, so that the gas production will increase due to the increase of digester size.

LAND USE FOR WASTE MANAGEMENT AND SANITATION IN URBAN AND RURAL SETTINGS IN DEVELOPING COUNTRIES

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Abstract

As per WHO estimates eighty percent of all illness in developing countries is associated with unsafe water and sanitation which could be effectively prevented through judicious use of land and water in rural and urban settings. Urbanization has become irreversible since the turn of the last century. To understand this urban phenomenon, it is important to note that in 1950, less than one-third of the world's population was urban, this means that 740 millions urban dwellers for about 1.8 billion rural. This proportion of those living in urban areas is greater than half of the total world population. The figure will approach 5 billion by the year 2030 given an estimated 180,000 people that are being added to the existing urban population daily. Urbanization in Africa has been phenomenal and puzzling with a rapid shift from a rural proportion of about 80% in 1960 to estimates of 52% urban currently. It is estimated that by 2030, the continent may attain 80% urban proportion. This phenomenal growth has consequences on ecological and social concerns associated with human health.

Total sanitation is a must to ensure dignity and privacy of women in developing countries where women go out for defecation, prevention of disease, better and healthy life, personal comfort and convenience, avoid pollution of water sources. To ensure environmental sanitation, safe disposal of waste water is a must. For that matter it is important to construct a drain up to a safe distance from water sources, divert drain to kitchen garden, construct soakage pit, connect with community drain etc. Likewise for safe disposal of human excreta; construct latrine at home, choose any technological option which suits, water pour flush latrines with – 2 leaching pits / single pit / over the pit and for water scarce area – VIP Toilet. For safe solid waste disposal, use dust bins, dug a pit in campus, collect all waste in it, reuse possible part, dispose rest by composting. For sanitation in community settlement in rural and urban settings there should be no garbage pits on road side, keep surroundings of water source clean, construct concrete/cemented roads, construct drains for waste water, make arrangement for regular cleaning of road, drains and community toilet, promote plantation, toilet complexes in schools and community centres. As per available information annually about 2,500,000 diarrhoea deaths are recorded globally and 600,000 in India alone. In India more than 1,800 million person hours are lost every year due to diarrhoea only. On the other hand through better management % reduction in diarrhoea is about 30% in Burma, 48% in USA and 35% in Bangladesh. Water and sanitation related diseases are: diarrhoea jaundice, typhoid, poliomyelitis, malaria, filarial, guinea worm and trachoma etc.

Need for human resource development is thus imperative that includes development of qualified and motivated man power comprising of both technical and social aspects covering following areas: sanitation awareness and hygiene education, technical training on appropriate technology, project planning, implementation and monitoring, implementing functionaries and information pertaining to appropriate sanitation technologies involving grass root level functionaries, women groups, youth club members etc. Awareness must be created with respect to linkage among land and water use, sanitation and health, hygiene education, motivation to community towards improvement of total sanitation.

HOST GENOTYPE – *AZOTOBACTER CHROOCOCCUM* – ARBUSCULAR MYCORRHIZAL FUNGI INTERACTIONS IN RELATION TO NUTRIENT USE EFFICIENCY IN WHEAT

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Abstract

The use of biofertilizers is being considered as an integral component of integrated nutrient management strategies due to soil health and economic reasons. Nitrogen, phosphorus, micronutrients contents should be maintained in appropriate quantities for maintaining sustainability of production systems through coherent microbiological processes in rhizosphere of crop cultivars. Diazotrophs like *Azotobacter chroococcum (Azc)* fix nitrogen and synthesize auxins, cytokinins, and GA-like substances, and these originating from rhizosphere/root surface are the primary substances controlling the enhanced plant growth. Likewise Arbuscular Mycorrhizal Fungi (AMF) improves phosphorus uptake and plant water relations.

Therefore, it is necessary to find the compatible partners, i.e. a particular plant genotype and a particular *Azotobacter* strain that will form a good association to ascertain the high effectiveness of inoculants. Agronomic significance of its application includes increased seed germination, better root development, increased water uptake and higher nutrient efficiency. This paper deals with our experiences related to crop effects of bioinoculants, colonization behaviour of *Azotobacter* in rhizosphere, *Azotobacter* – AMF interactions in rhizosphere for survival counts of *Azotobacter* and nutrient uptake, phosphate solubilization, root exudates and localization of bioinoculant responsive genes on different wheat chromosomes and specific genetic variability for enhanced uptake of macro and micro plant nutrients.

Inoculation of AMF and AMF + *Azc* led to increase in peduncle length, flag leaf area, number of grains spike^{-1}, grain weight, biological yield and grain yield per plant Maximum response to inoculation with AMF + *Azc* was evident for peduncle length in WH 157, flag leaf area in WH 147, number of grains spike^{-1} in WH 542, grain weight in PBW 175, grain yield in WH 147 and biological yield in WH 147. In crosses, these parents contributed towards higher magnitude for these traits. Varietal response was found to be heritable. Maximum *Azotobacter* counts were found 80 days after sowing (5.4×10^6) in AMF+*Azc* treatments of cross WH-147 x PBW-175 (335×10^4) followed by WH 147 x WH 542 (275×10^4) and WH 147 x WH 157 (81.5×10^4). The bacterial population increased at faster rates in the rhizosphere of each cross when AMF was co-inoculated.

Wheat genotypes differed from each other for root biomass, total root length and AMF infection of roots. PBW 175 followed by WH 542 had maximum root biomass, root length and AMF infection in roots. Inoculation of *Azotobacter chroococcum* along with AMF had complementary effects on AMF infection particularly in PBW 175. The highest total root length was found with cross WH 147 x PBW 175. This cross included parents WH 147 (suitable for medium fertility and moisture) and PBW 175 (adapted to drought stress). The cross WH 533 x R 3077 recorded high values for the micronutrients Fe (287 ppm) and Mn (55.0 ppm) under VAM and Zn (29.43 ppm) under dual inoculation. Pedigree selection in crosses WH 147 x WH 533 and WH 147 x Raj 3077 can be effective for breeding pure lines in wheat for sustainable agriculture (low input genotypes responsive to biofertilizers like AMF and *Azotobacter*).

SUSTENANCE, SUBSISTENCE AND SUSTAINABILITY, WITH SPECIAL REFERENCE TO AFRICA

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Abstract

In this Charles Darwin Memorial Year, let us put our question in an evolutionary-historical perspective. The evolution of the small human groups which we consider nowadays our ancestors, cared for their **sustenance** – if not, their survival would not have been possible. **Subsistence** was much later "the order of the day". When the Agrarian societies came into existence, they did their best to become self-sufficient. The concept of "subsistence-economy" was extensively discussed in social sciences in general and development anthropology in particular. Later on, they realised that more exchange with neighbouring ethnic groups would be beneficial to all sides. **Sustainability** as a concept was brought up in the 18th century in Northern Germany, in connection with the need of wood and afforestation for the benefit of coming generations.

In our century, we realise that sustainability in every field is essential and the concern of all of us for the future of humankind.

The paper deals in general terms with the three concepts mentioned in the title. It also specifies the basic correlation of production and use of natural resources (endemic and imported) population growth and expansion on the African continent in pre-colonial times. The example of the past can explain the uneasy and unfortunate coexistence of the three modes until present times.

PHOSPHORUS EFFICIENCY AND P INFLUX OF MAIZE AND GROUNDNUT – A COMPARATIVE STUDY IN SOIL AND SOLUTION CULTURE

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Abstract

Crop species differ in their P-efficiency. To investigate the reasons for the differences in P-efficiency of maize and groundnut as well as among their growth stages, a field-experiment in low-P Alfisol soil and a solution-culture experiment were carried out. Maize was more P-efficient compared to groundnut in field condition. However, P-efficiency varied during the growing season. Maize was inefficient in early stages, but was very efficient at later stages; in contrast, groundnut was very efficient in the beginning and was inefficient later. P-influx was the major factor that determined the P efficiency of maize and groundnut as well as its changes during the growing season. Phosphorus influx was calculated for maize and groundnut grown in flowing nutrient solution culture at P concentration of 0.2, 1 and 100μM. At 1μM P, maize was more P-efficient producing up to 90% of its maximum yield as compared to groundnut with only 20% of maximum yield due to three-times higher P-influx in maize. In contrast, groundnut had even a negative P-influx at 1 μM P indicating that groundnut needs much higher P concentration at root surface for maximum growth. This result contrasts with the findings of field experiment where groundnut in early stages grew with no limitations on a low-P soil, while maize yielded only 15% of its maximum and this contrasting result was probably due to some rhizosphere soil-root interaction enhancing the soil P availability e.g. root exudates and AM infection which might have played a role in the field experiment.

TRITICALE, A VIABLE AND ADAPTABLE CROP: HISTORY, PRESENT SITUATION AND PROSPECT

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Abstract

Small grain cereals are the most important food and feed sources worldwide. Triticale *(XTriticosecale Wittm.)* the first flourishing man-made cereal was intentionally formed 125 years ago. Since then, the evolution and vision of this crop has been the topic and enthusiastic interest of plant scientists, breeders, farmers, millers, grain traders, food and feed industry specialists. It has the excellent capability to adapt well to harsh weather conditions, infertile soils and recent low-input agricultural systems. Triticale, however, a new crop and it was until the late 1960's when the commercial releases became available for farmers. The present area is circa 3 million ha and the larger areas of triticale are still in Europe where the broad environmental conditions of agricultural production are more favorable than some other parts of the world (i.e. some territories of Asia or Africa). Large areas of triticale planted in Poland, Germany, Hungary, France and UK. In these countries, triticale is a highly accepted crop in the areas where other cereal crops have low yields. Experimental data in Hungary confirm that in dry years, triticale outperformed wheat even in the best cereal lands. Triticale normally has superior resistance to foliar diseases than wheat, including rusts, smuts, bunts and powdery mildew. However, as it broadens in production area, it gets disease and there is considerable genotypic variation in terms of disease resistance. In spite of the superiorities of triticale, it is still an „on-farm" crop in the EU used mainly as feed grain for swine and poultry diets. However, it is increasingly exploited by baking and cereal breakfast industry mainly in Poland and Germany. Triticale has a nutritional advantage over other grain crops due to its beneficial macro and microelement content, amino acid profile advantageous starch-, fiber-, sugar- and antioxidant compounds. For ruminants, triticale can be used either as a grain or as whole-crop silage or pasture forage but these applications hold rather a promise for future in larger extent than current utilization. Based on its benefit, triticale has a special position in future low-input cropping systems and in dry, infertile areas of the world but in recent days, triticale spread gradually and translating its biological potential into market potential is slow worldwide. The extent of this position will depend on mainly economical factors. Firstly, similarly to wheat, markets for triticale grain industry must be developed. The role for triticale will also depend on economic conditions and the governments wills that dictate whether marginal lands are used for arable, forestry or pastoral purposes. Triticale production is environmentally sound and in an increasingly aware, society will have a preference to it. Probably the main factor which will influence the role that triticale has in future low-input systems is its production cost relative to other cereals. Given that it can be grown with reduced levels of inputs and that it can out-yield other cereals on marginal land and drought, it will have a competitive advantage over other cereals in terms of input costs that are increasing fast in recent years. Prospect of cereal grain for energy (biomass) production will provide new routes in triticale production and utilization. Continued progress in triticale breeding in many countries will help these efforts.

TECHNIQUES OF VEGETATIVE MULTIPLICATION IN *PONGAMIA PINNATA*: A BIODIESEL PLANT

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Abstract

Pongamia pinnata family Leguminaceae is the promising species as a source of biodiesel. Different techniques for multiplication (stem cutting, air layering, girdling and leafy cuttings) of vegetative propagation of *Pongamia* was studied to develop a protocol for cloning the desired genotypes. Vegetative propagation is an indispensable component for ensuring quick genetic gains by mass multiplication of superior genotypes with a high degree of homogeneity. It provide fast and simple tool for replicating clonal material for identical genotype with the source plant for high genetic gain.

The study was conducted at National Research Center for Agroforestry, Jhansi. The effect of rooting hormones on juvenile shoot cuttings was observed for four concentrations (100, 200, 400 and 600 ppm) of IBA, NAA and the combination of IBA and NAA and control in different seasons. The maximum rooting (90.33%) and tap root length (27.4 cm) were observed for IBA 400 ppm treated cuttings during spring season. Cuttings of *Pongamia,* propagated through air layering were treated with different concentrations *viz*. 100, 200, 400, 600, 800 and 1000 ppm of IBA and control. The cuttings treated with 600 and 800 ppm concentrations of IBA was found in 25-30 days for root formation with high nodule which help in establishment of the rooted plants with maximum survival (94.66 and 93.33%, respectively). Maximum growth and biomass was found in cuttings treated with IBA 600 ppm solution.

In girdled and non girdled cuttings same treatments of IBA (as per air layering) were given to the cuttings. Girdled cuttings resulted in more sprouting percent (73.33%) as compared to the ungirdled cuttings (63.33%). The girdled cuttings exhibited 59.67% rooting when 52.54% rooting was observed in the ungirdled ones. In case of leafy cuttings maximum sprouting and rooting (71.00% and 63.66%, respectively) were observed with large cuttings, leaves intact +IBA 400 ppm.

These techniques will be quite useful for large scale multiplication of *P. pinnata* species, which is being promoted on a very large scale due to its importance as biofuel to meet out the challenges of worldwide crisis of fuel.

GENOMIC STRATEGIES TO UNDERSTAND AND IMPROVE ABIOTIC STRESS TOLERANCE IN CEREAL CROPS

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Abstract

The major source of calories in the human diet comes from the cereal grains, which are grown from the tropics to the edge of the Arctic Circle. In most areas, there has been a steady increase in cereal crop yields over the years. In 1960, an average hectare of arable land supported the nutritional needs of 2.4 persons, which increased to 4.5 persons by 2005 and could rise to 6.1 persons by 2050. However, the ability of agriculture to meet the global needs for foods in the future is a major concern in many parts of the world. During the last decades we have seen how population growth and human activities have triggered climate change, which has become a challenge for sustained crop productivity. High temperature, drought and salinity are some of the serious abiotic stresses affecting crop production world-wide today. Thus, it is imperative to develop crop cultivars with enhanced stress-tolerance to alleviate the losses and to expand cultivation to marginal lands which are currently not amenable to agriculture. Tolerances to stresses are complex traits that involve many different genes and gene networks. To develop crop cultivars with enhanced abiotic stress tolerance, we need to elucidate the biochemical mechanisms underlying plants response to environmental cues.

Genomics is a multidisciplinary approach to study genomes by combining genetics, biochemistry, and molecular biology with informatics and automation technologies. We have used genomics to characterize the genetic basis and molecular mechanisms underlying low-temperature (LT) tolerance in winter wheat. The ability to withstand LT stress during the winter is a major factor restricting winter wheat production at northern latitudes. The genomic regions affecting LT tolerance in a winter-hardy wheat cultivar, Norstar, were identified by mapping quantitative trait loci (QTLs). Chromosome 5A carried the major LT tolerance QTL, which has been partially characterized by sequencing corresponding BAC clones derived from a bacterial artificial chromosome (BAC) library of Norstar. A cluster of C-repeat binding factor genes that are known to control expression of cold-regulated genes were located under the 5A QTL. Quantitative transcriptome analysis of crown and leaf tissues has revealed a more consistent accumulation of cold-responsive gene transcripts in crowns as compared to leaves. Several novel LT-induced transcripts in wheat have been identified and their functional roles are being studied. Based on the genetic markers developed in this study, novel wheat cultivars are under development. Successful production of winter wheat with superior cold-hardiness will allow expansion of winter wheat cultivation to higher latitudes and result in higher wheat production as winter wheat yields per hectare are up to 20-30% higher than for spring wheat.

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CURRENT CHALLENGES OF CROP CULTIVATION IN PASTORAL DRYLANDS OF ETHIOPIA

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Abstract

The Borana Pastoralists are known for their well-established traditional resource management system. Land classification for different uses, herd splitting and mobility, fencing and maintenance of some reserves (Kalo) and water points have been their traditional strategies for sustainable resource utilisation. Dry and wet season grazing lands are marked based on established criteria. Furthermore, villages (Olla) had never been established arbitrarily. Especially, cultivation was not part of the pastoral production system. However, cultivation is becoming one of the major challenges in these marginal grazing lands due to increased human and livestock populations, low milk production, rangeland degradation, inappropriate extension concepts and erratic rainfall. Data was collected from August 2001 to September 2002, using group discussion and interviews in such a way that both female and male pastoralists are included. Current challenges of cultivation on line with the Pastoralists' justification for and against cultivation are discussed. Impacts of cultivation on livestock production and ecological stability are elaborated. Finally, trends towards cultivation and recommendations are presented.

Keywords: Borana pastoralists, cultivation, rangeland degradation

BIO-ECONOMIC ANALYSIS OF SUSTAINABLE LAND USE OPTIONS IN THE MOUNTAINS OF NEPAL

Romy Das

Abstract

Serious concerns have been raised over intensive cultivation of sloppy and marginal land in the mountains of Nepal which leads to huge soil erosion and fertility degradation. Extent and intensity of degradation in fragile mountainous region has greatly threatened the agricultural production as well as food security in the region. In this backdrop, the present paper attempts to examine the economic viability of various land use options to ameliorate such problems in the context of the mountain farming system of Nepal. The study used biophysical model, soil change under agroforestry (SCUAF) to predict impact of soil erosion on the crop yield and soil nutrient content under status quo systems as well as proposed land use options in long term. The cost benefit analysis was used to examine the economic performance considering 30 years of time horizon. The alternative land use option in this study implies to the various soil conservation technologies; minimum tillage, hedge row intercropping and legume integration.

The results show that a minimum tillage maintains higher crop yields than conventional tillage systems leading to positive returns up to longer period. Similarly, hedgerow technology and legume integration are found more profitable for the farmers in comparison to sole annual cropping. Nevertheless, the establishment and maintenance cost particularly in case of hedge row intercropping reduces farmers' income substantially in the beginning. The study concludes that though land use options under evaluations are effective in controlling erosion and maintaining yield significantly in long run, they are not economically feasible at the farmers' socio economic conditions in short run. Nevertheless, these technologies have high offsite benefit for the downstream water user. The positive externalities of these technologies justifies providing the adequate support to the farmers for the wider adoption and compensating the economic loss during transition phase of adoption. The study has a high policy implication for sustainable agriculture production in mountains of Nepal.

Keywords: Land Use Options, Hill Farming System, Minimum Tillage, SCUAF model, Cost-Benefit Analysis,

STRATEGIES FOR DEVELOPING DUAL-PURPOSE "FOOD-FUEL" CROPS FOR WATER-LIMITED AND LOW-INPUT SYSTEMS

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Abstract

Agricultural systems in the tropics and subtropics, and the food security and social peace that depend on them, stand to face their greatest challenge in modern times, brought about by climate chance, increasing occupation of arable land by energy crops, competition for scarce water and an ever increasing number of mouths to feed. One of the key questions is how the rapid growth of the energy crop sector can be converted from a threat to the poor to an opportunity, enabling their participation in the economic opportunity. This participation of the poor would enable them to invest in the quality of their land resources, intensify their cropping systems and, most importantly, buy food as the traditional subsistence systems no longer provide enough of it.

Research is under way to develop fuel crop technologies that may help resolving this problem in two ways, by (1) developing food-fuel crops providing food grain and substrate for bio-ethanol at the same time, and (2) decentralizing part of the processing away from the refineries, thereby providing supplemental sources of income at the village level. A major European funded project foments these developments for several, namely water-limited environments in the tropics, with emphasis on breeding.

So far the best candidate plant for developing food-fuel combined technologies is sweet sorghum. The plant develops sugar concentrations comparable to those of sugar cane in the stems while producing a modest but valuable grain yield. Furthermore, the biomass residues are of high feed value for livestock or can be used as energy source for the distillation. Sorghum is a highly water use efficient and grows on poor soils. Its C4 metabolism enables high biomass production, thus limiting physiological competition between sugar accumulation and grain filling, as indicated by the ongoing research. The energy and greenhouse gas balance of this technology would be comparable to that of sugar cane, and would be much superior to that of maize, cassava or rape seed.

The decentralization strategy aims at pre-processing at the farm or village level, including sugar extraction, fermentation and pre-distillation providing low-grade alcohol. This intermediate product is much cheaper to transport to distant industrial distilleries than fresh biomass and can be stored indefinitely, thus reducing costs and increasing flexibility. The concept can theoretically be applied to other energy crop technologies but is particularly pertinent for food-fuel plants (unlike Jatropha) grown in comparatively marginal environments as part of diverse cropping systems.

FACING THE CHALLENGES OF THE GLOBAL HUNGER AND POVERTY CRISES

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Abstract

Whereas good progress was made in reducing chronic hunger in the 1980s and the first half of the 1990s, hunger has been slowly but steadily on the rise for the past decade, FAO said. The number of hungry people increased between 1995-97 and 2004-06 in all regions except Latin America and the Caribbean. But even in this region, gains in hunger reduction have been reversed as a result of high food prices and the current global economic downturn. World hunger is projected to reach a historic high in 2009 with 1 020 million people going hungry every day, according to new estimates published by FAO in June 2009.

The most recent increase in hunger is not the consequence of poor global harvests but is caused by the world economic crisis that has resulted in lower incomes and increased unemployment. This has reduced access to food by the poor.

A dangerous mix of the global economic slowdown combined with stubbornly high food prices in many countries has pushed some 100 million more people than last year into chronic hunger and poverty, the silent hunger crisis – affecting one sixth of all of humanity – poses a serious risk for world peace and security. We urgently need to forge a broad consensus on the total and rapid eradication of hunger in the world and to take the necessary actions.

Poor countries must be given the development, economic and policy tools required to boost their agricultural production and productivity. Investment in agriculture must be increased because for the majority of poor countries a healthy agricultural sector is essential to overcome poverty and hunger and is a pre-requisite for overall economic growth.

The UN-Energy paper which focused on “The Energy Challenge for Achieving the Millennium Development Goals”, pointed out that available energy services fail to meet the needs of the world’s poor, with 2.4 billion people relying on traditional biomass for their energy needs and 1.6 billion not having any access to electricity. The basic commitments to poor people cannot be met without a far more focused approach to energy services.

World hunger is not caused by the lack of food, but by poverty and the lack of adequate income. Eliminating high tariffs on biofuels, combating agricultural subsidies and creating a global biofuels market will certainly help to create new opportunities for developing countries, contributing to the creation of new jobs and to combat rural poverty. Bioelectricity obtained from cogeneration can help to provide electricity to remote rural areas and to further promote economic development.

Many of the world's poor and hungry are smallholder farmers in developing countries. Yet they have the potential not only to meet their own needs but to boost food security and catalyse broader economic growth. To unleash this potential and reduce the number of hungry people in the world, governments, supported by the international community, need to protect core investments in agriculture so that smallholder farmers have access not only to seeds and fertilisers but to tailored technologies, infrastructure, rural finance, and markets.

For most developing countries there is little doubt that investing in smallholder agriculture is the most sustainable safety net, particularly during a time of global economic crisis.

The rapid march of urgent hunger continues to unleash an enormous humanitarian crisis. The world must pull together to ensure emergency needs are met as long term solutions are advanced. The present situation of world food insecurity cannot leave us indifferent. The main obstacle in achieving a solution is the lack of political will, nationally, regionally and globally. Business as usual will lead to more disasters. What is needed is a clear commitment towards adoption of technologies which enables poverty alleviation and development of rural communities.

A wise solution to alleviate hunger and poverty is not simply to distribute food supplies by itself. A more fundamental approach to the problem is needed. We must share technology with which people can overcome hunger by their own means and devices. This is well defined in the UN-FAO-Concepts of Integrated Energy Farming and Rural Settlements which will be discussed at the Seminar.

THE IMPACT OF CHANGING LAND TENURE REGIME IN CAMEROON ON WOMEN'S RIGHTS TO LAND AND CONTRIBUTION TO FOOD SECURITY

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Abstract

Cameroon is one of the food breadbaskets of Central Africa, with potentials to feed its over 15 million inhabitants and the population of its neighbours. Women constitute the vast majority of small farmers who are mostly involved in the food production sector. They work on small parcels of land that are either leased to them or which have been acquired through family bonds or purchase. Today, with increasing and competing demand for land from urbanization, urban services and infrastructural development, the contribution of rural women to food security hangs on the balance. The situation is further complicated by the current change in land ownership that deemphasised communal land ownership in favour of private ownership. In the present context, food production is threatened, as land and women's labour respectively, opt for other opportunities that offer higher rents and wages.

This paper explores the changing land tenure system in the North West and South West regions of Cameroon and its implications on women's rights to land as it affect food security in Cameroon and the Central Africa sub-region. It examines the emerging phenomenon of private land titles, farmer/grazier conflicts and other gender based conflicts which affect women's farming activities and output within the context of increasing population and land scarcity. The paper highlights the challenges the current situation poses to traditional and administrative authorities in the region and advocates for land policies and reforms that mainstream gender in an effort to sustain women's productive activities and food security in Cameroon.

THE DEVELOPMENT OF VARIOUS ECO-FRIENDLY MODELS OF SOLAR ENERGY FOR SUSTAINABLE GROWTH OF INDIAN AGRICULTURE

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Abstract

About 70% of India's population is linked with agriculture and the economy of the country greatly depends on the agriculture production. Baring the present recession, the economic growth of the country was around 8% in the recent years but the agriculture growth was very less (less than 2%). Currently, Indian agriculture consumes relatively very less energy as compared to energy consumption in other sectors. This situation hinders the desired growth rate of 4% in the agricultural sector. At present, the availability of electricity is less or negligible in rural India. One of the hopes to attain the required rate of growth in agriculture lies in the increased use of renewable energy for different purposes in agriculture. The use of renewable energy in the form of open sun, drying including solar energy and other resources of solar energy are the most common applications in the agricultural sector. There is a need to develop appropriate models and increased use of renewable energy in more organized way for sustainable development of agriculture. The various forms of renewable energy can be used through improved applications.

The potential of solar energy applications can be solar driers for drying of crops, concentrators for cooking, water heating systems, flat plate collectors for storage of energy. Though there is round the year availability of quality sunshine, the use of solar energy through the photovoltaic (PV) system is not very successful in India. These passive applications require activeness. However, the applications of PV systems in water pumps, lighting is the most successful form of all. The use of greenhouses for production and processing of crops is also growing day by day. With more and more business houses coming into the agriculture production, the greenhouse provides control environment for high value crops.

This paper aims at to report and discuss the appropriate models of solar energy and their application in different sectors of agriculture for sustainable growth of agriculture and agro based industries of rural India.

BIOGAS: AN ECO-FRIENDLY SOURCE OF RENEWABLE ENERGY FOR SEMI-URBAN AND RURAL HOUSEHOLDS IN INDIA

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Abstract

In this energy deficient world, there is need to adopt different sources of energy which are renewable, less demanding on land as well as its resources and also eco-friendly. Biogas is one such option. It has been adopted since a long time in India and other developing nations like China. Many villages renamed as “Nirmal (clean) Villages” in M.P. (India) have fully adopted biogas as an alternate source for cooking purposes by small household. Every household in those villages has its own small biogas plant. There have also been some efforts by cattle dairy enterprises to generate electricity on their own enterprise and also to supplement the other complementary enterprise like poultry in semi-urban areas in central India. Due to certain disadvantages associated with the generation of methane gas from the cattle dung like large hydraulic retention time (HRT), low gas production in winters, less quantity of dung available with small households has been affecting its popularity. By adopting certain techniques like fixed film materials, using certain types of additives and by varying the slurry concentration, one can overcome these limitations and increase the amount of biogas obtained from the cattle dung as well as other solid biomass substrates like crop residues, weeds etc.

The present paper deals with some successful stories of generating biogas for rural household, energy security in semi-urban and rural India and as well as increasing the efficiency of biogas generation from cattle dung by the use of various fixed film materials like clay etc., use of different additives like OSW (onion storage waste) and using different slurry concentrations. It was found that by using clay as fixed film material and OSW as additive and 1:4 (dung: water) as slurry concentration, one can substantially increase the amount of biogas obtained from a given quantity of cattle dung for improving the standard of living and environment in rural and semi-urban India.

CURRENT STATUS AND FUTURE SCOPE OF GENETICALLY MODIFIED AMERICAN COTTON HYBRIDS IN AFRICA AND ASIA

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Abstract

Cotton was one of the earliest crops to be genetically engineered by the industry. The concept of genetic engineering has been exploited to introduce the Bt gene responsible for controlling cotton against Lepidopteron (*Helicoverpa armigera*, *Earias* spp. [including *E. insulana* and *E. vittella*] and *Pectinophora gossypiella*) that are primarily responsible for restricting the full exploitation of the potential yield.

Cotton is an important crop and millions of people derive their livelihood directly or indirectly from cotton production and its trade. Most of the cultivated cotton belongs to *G. hirsutum* groups which is cultivated in all parts of cotton growing areas. Most of the cotton growing countries have main insect control targets, as bollworm complex, which accounts to the highest pesticide expenditure.

To sort out the problem to a certain extent and to make cotton cultivation more attractive to reinforce the farmers with the capacity to make them more competitive vis-à-vis the world market, the cultivation of Bt cotton was permitted in almost all the cotton growing states especially for the economic management of the bollworm complex (based on its large scale testing and consideration of its biosafety).

Some of the priority research efforts to sustain the effectiveness of Bt cotton gene against bollworm are to develop genetically modified cotton varieties/hybrids resistant to sucking pests and disease like cotton leaf curl virus and suitable for abiotic stresses.

It is also pertinent to ensure that in large areas it is allowed to remain GE free to avoid any mishap due to break down of Bt toxin. Diversity is very important in order to avoid development of resistance against a particular Cry Gene(s). Therefore more events should be in offing on continuous basis so that bollworms are not able to acquire resistance.

AGRICULTURAL EXTENSION AND RURAL ENVIRONMENT: FOCUS ON WATER RESOURCE

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Abstract

Rural environment represents the framework of regulations, Institutions, and practices in villages defining parameters for the sustainable use of environmental resources while ensuring security of livelihood and a reasonable quality of life. While the scope of environmental infrastructure is often narrowed down to the provision of suitable water supply, sewerage and sanitation, it has within its purview (a) acquisition, protection, and maintenance of open spaces, (b) clean up and restoration of degraded lands, (c) integration of existing wildlife or habitat resources, (d) sustainable approaches to controlling flooding and drainage, (e) developing river corridors and coastal areas, and (f) forest management.
Rejuvenation of natural resources through activation of watersheds, renewal of wastelands along with enhancement of farm productivity, is a component of environmental infrastructure that is attaining increasing importance as expanding anthropogenic activity stresses natural resources beyond their natural regeneration capability.
The focus here is on natural resources, common properties, and rejuvenation of rural environment, specially the water resource.

Agricultural activities that cause land degradation include shifting cultivation without adequate fallow periods, absence of soil conservation measures, cultivation of fragile lands, unbalanced fertilizer use, faulty planning or management of irrigation. Improper agricultural practices are usually observed under constraints of saturation of good lands and population pressure leading to cultivation of ‘too shallow’ or ‘too steep’ soils and ploughing of fallow land before it has recovered its fertility. Overgrazing and over-extraction of green fodder lead to forest degradation through decreased vegetative regeneration, compaction of soil, and reduced infiltration and vulnerability to erosion.

A Johad is a dug-out pond, created at a place chosen with native wisdom, informed by remembered patterns of water flow during the rains to harness the rainwater run-off with high embankments on three sides. The height of the embankment depends on the volume of run-off from the catchments. The water storage area varies from 2 hectares to a maximum of 100 hectares. The water collected in a Johad during monsoon penetrates into the sub-soil and recharges the groundwater, improving soil moisture in vast areas mostly downstream. Apart from arresting and storing rainwater, it stops soil erosion, mitigates flood, and ensures water availability in wells for several successive drought years. The groundwater can be drawn from traditional open wells, built and maintained by the villagers themselves. The water from the Johad is also directly used for irrigation, watering of domestic animals and other household purposes. During the dry season, when the water gradually recedes in the Johad, the land inside the Johad becomes available for cultivation. This land, by receiving good silt and moisture, allows crops to grow without irrigation. Johad is built using simple technology and local materials.

In the Alwar district of Rajasthan it took three years to build the first Johad. In the fourth year, Tarun Bharat Sangh, a non-governmental organization (NGO) actively helping villagers, had

built fifty Johads. As on date, 9000 such structures exist catering to water needs of more than 1000 villages. This area which was classified as ‘dark zone’ in 1995 was reclassified as ‘white zone’ in 2005.

The governance structure is likely to change as a result of decentralization from centralized to localized, with the ‘people’ at the centre. Ideally, the higher authorities will not manage natural resources, but through a participatory process, the local people will manage them, thus resulting in a change in the pattern from a ‘command and control’, to a ‘responsive and accountable’ operative system.

The new people-centred bottom-up paradigm in development thinking has created the overly optimistic view, that decentralization will produce just and equitable outcomes for all, and that engaging the people will also act as a check on state power, thus helping to democratize local governance.

The new paradigm stresses the involvement of local people in contrast to the top-down paradigm, and tends to dominate management of natural resources at the local level.
It has been argued that the emergent paradigm for humans living on and with the earth brings together decentralization, democracy, and diversity.

Farming systems vary with agro-ecological conditions and no single intervention will work as a magical cure for improving farm productivity. In some regions, solutions for increasing yields may involve a shortening of fallow periods and extension of cropping periods while in others where soil fertility and/or access to purchased inputs is good, solutions such as annual cropping or multi-cropping without fallow would work. Again, farming systems based on tree crops, are suitable for some regions only and should be encouraged accordingly. Further, the degree of market integration, choice of crops and cropping systems, use of conservation technologies and use of purchased inputs and their effects on the farming system are all important in determining the sustainability of particular farming systems.

Revival of agricultural dynamism calls for corrective steps to deal with the near collapse of the extension systems in most states and the decline in agricultural research universities. Lab-to-land concept should be encouraged and put to practice by providing land-users multidisciplinary technical information and viable land-use options and alternatives identified for various agro-ecological and socio-economic units. Crop combinations and rotations suitable for different agro-ecological regions (as suggested by the Indian Council of Agricultural Research) need to be advocated for better land management. There is a need to stay abreast with evolving resource conservation technologies and practices and on analysing the conditions and principles of sustainable land use. Efficient use of marginal lands needs to be encouraged and areas of untapped potential developed to ensure optimal utilization. For agricultural diversification to be a major element in the agricultural growth strategy, action on several fronts is necessary.

EFFECT OF DIFFERENT NITROGEN AND POTASSIUM SUPPLY ON YIELD AND SYMBIOTIC DINITROGEN FIXATION OF BLUE LUPINS (*LUPINUS ANGUSTIFOLIUS* L.)

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Abstract

The effect of nitrogen and potassium supply on symbiotic dinitrogen fixation and yield of blue lupins were investigated in field plot experiments with ^{15}N labelled fertilizer ($(^{15}NH_4)_2SO_4$). The amount of symbiotic fixed dinitrogen was calculated as the difference between total plant N and the sum from fertilizer derived N, seed borne N, soil derived N and N deposition.

The following results were obtained:

1. *Lupinus angustifolius* fixed considerable amounts of dinitrogen between flowering and ripeness. In this stage we observed a strong increase of dry matter yield also.
2. K supply stimulated fertilizer uptake, but did not influence dry matter yield or biological dinitrogen fixation.
3. Mineral N supply at sowing increased only slightly the dry matter production and nitrogen accumulation of the blue lupins. The symbiotic fixed N was not influenced by N fertilizing at sowing.
4. Mineral N supply at flowering reduced the dry matter production, N uptake and symbiotic dinitrogen fixation slightly.
5. The relationships between biological dinitrogen fixation, supply of combined nitrogen and plant yield of blue lupins were more similar to yellow lupins and contrary to white lupins. The biological N_2 fixation of *Lupinus angustifolius* appears relatively tolerant to mineral N supply.
6. Blue lupins need for yield formation neither a N fertilization at vegetation start nor a late N supply at flowering.

FINANCIAL VIABILITY OF AGRO-FORESTRY FOR BIO-ELECTRICITY GENERATION ON VARIOUS FARM TYPES IN THE WESTERN CAPE, SOUTH AFRICA

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Abstract

South Africa relies heavily on coal for electricity generation. While projections of known reserves indicate sufficient coal for 80 years, air pollution from the coal power plants causes serious environmental damage. Some local and regional municipalities are investigating the financial-economic viability of bio-energy, like the Cape Winelands District Municipality (CWDM) in the Western Cape Province. CWDM is located more than 1 200 km from the coal power plants and wants to become less dependent on coal as energy source due to the reasons given above and to become less vulnerable to break downs in the power supply over such a long distance. CWDM lies in a fairly dry area with a Mediterranean climate. The production of lignocellulosic biomass for bio-electricity generation seems to be the most appropriate option to become less dependent on fossil fuel.

The Western Cape Province is less preferred for pulp and construction wood production, due to the relatively low productivity expressed as the mean annual increment (MAI) of typically 12 m^3/ha/annum, compared to a typical MAI of 20 m^3/ha/annum in the northern, more subtropical part of South Africa. Biomass available from the limited areas still under plantations destined for construction wood is not regarded as adequate supply for even a 2.5 Megawatt bio-electricity plant. The viability of production of woody biomass in high density short rotation plantation systems as a sole operation or integrated as agro-forestry activities into existing agricultural operations required investigation. Three scenarios were assessed.

The first scenario describes woody biomass production as a single production activity on fynbos/uncultivated land, not competing with other agricultural activities. Provision was made for four levels of land productivity and resultant land values. The only capital expense provided for was land; no other capital investments made were included. All biomass-producing activities were assumed to have been undertaken by contractors to minimise fixed costs. The return on investment is positive, and the highest for medium priced land and medium productivity levels, compared with more productive but more expensive land, or cheaper but more marginal land.

In the second scenario, biomass production is introduced as an additional enterprise on a dryland winter-grain farm, typically in a rainfed grain- and livestock-producing farming area. The return on investment is barely positive at current electricity rates based on ‘cheap’ coal prices.

The third scenario describes biomass production in an intensive farming environment. The return on investment is negative, showing that biomass production cannot compete with high-value crops on expensive land at current electricity tariffs.

THE EFFECT OF STRAW APPLICATION ON ENERGY BALANCES IN THE LONG-TERM FIELD EXPERIMENT IN TRUTNOV

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Abstract

Energy balance certainly belongs among important indicators of sustainability of agro-ecosystems. This contribution is based on a paper published by Rathke, Körschens and Diepenbrock (2002) in which the substance and energy balances were evaluated in the Static Fertilization Experiment Bad Lauchstädt.

Results of a long-term field experiment in Trutnov were evaluated. The long-term field experiment in Trutnov was established on Eutric Cambisol, sandy-loam, altitude 427 m, in 1966. Its aim was to evaluate the effect of straw with mineral N added on crops and soil, as compared to the effect of farmyard manure. The experimental design is semi-random: three blocks of organic fertilization (Nil, Straw+N, and Farmyard manure), and in each one, six variants of mineral fertilization in four replicates (random). Data on crop yields (dry matter of the main and second products), energy input and energy output, over the time period from 1999 to 2006 (one eight years crop rotation) were supplied from the DAPOPO database.

Energy input was estimated according to Rathke et al. (2002) and it included fuel, seeds, plant pesticides, machines and organic and mineral fertilizers. Energy output was estimated as a gross energy content of the main and second products (average values over the whole crop rotation), using data published in the same paper (Rathke et al., 2002). Difference between energy output and energy input is energy gain or, in other words, energy efficiency (net efficiency of the solar energy accumulation). Average energy gain in mineral NPK variant over the non fertilized control was 46 GJ $ha^{-1}a^{-1}$. A comparable energy gain was also reached in NK variant (35 GJ $ha^{-1}a^{-1}$), while the energy gain in a single mineral N fertilized variant was 14 GJ ha^{-1} a^{-1} over the non fertilized control. Energy gain in the NP and in PK variants was similar, 22 GJ $ha^{-1}a^{-1}$ and 21 GJ $ha^{-1}a^{-1}$, respectively. Fertilization with straw pus N (StrawN) increased the energy gain by 26 GJ $ha^{-1}a^{-1}$ over the non fertilized control. Mineral fertilization NPK, NP, NK, N and PK in StrawN treatment increased the average energy gain by 64 GJ $ha^{-1}a^{-1}$, 46 GJ $ha^{-1}a^{-1}$, 60 GJ $ha^{-1}a^{-1}$, 32 GJ $ha^{-1}a^{-1}$ and 40 GJ, respectively, as compared to the non fertilized control. The highest energy gain was found in the FYM treatment. The FYM itself increased energy gain by 41 GJ $ha^{-1}a^{-1}$ over the non fertilized control and mineral fertilization NPK, NP, NK, N and PK in the FYM treatment increased the energy gain by 68 GJ $ha^{-1}a^{-1}$, 58 GJ $ha^{-1}a^{-1}$, 55 GJ $ha^{-1}a^{-1}$, 51 GJ $ha^{-1}a^{-1}$, and 45 GJ $ha^{-1}a^{-1}$, respectively.

Energy intensity and energy output/input ratio characterize environmental impact of the agricultural system (more specific, fertilization system). Energy intensity is the energy input related to cereal units (GE), calculated from the dry matter yields of the main and second products. Energy intensity increased due to the organic fertilization and mineral N fertilization. Similarly, the energy output/input ratio was lower in StrawN and FYM blocks and in variants treated with mineral N. Apparently, both organic and mineral fertilization represent a higher impact on the environment, in general, as compared to the non fertilized control. On the other hand, the effect of both organic and mineral fertilization on C sequestration (as one of the most important environmental issues) is highly positive.

EFFECT OF SEWAGE WATER AND SEWAGE SLUDGE ON SORGHUM

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Abstract

Sorghum is one of the four major food grain crops in the world and dietary source for millions of people in Africa and Asia. Large volumes of sewage water, the urban treated and untreated wastewater and industrial effluents are being used directly in agricultural soils for irrigation purposes around cities. Land application of sewage not only provides moisture but also provides high levels of nutrients and improves texture and stability of soil. But due to continuous use of sewage water in agriculture there may be heavy metal accumulation in soil. A field experiment was conducted to evaluate effect of sewage water and sewage sludge on sorghum (*Sorghum bicolor L.*). The soil of the experimental field was sandy loam in texture; low in organic carbon, nitrogen; low in phosphorus; high in potassium and slightly alkaline in reaction. The field experiment was laid out in split plot design with three replications. The treatments consisted of all irrigation with sewage water (4 irrigation), 3 irrigation with sewage water + 1 irrigation with tube well water, 2 irrigation with sewage water + 2 irrigation with tube well water, 1 irrigation with sewage water + 3 irrigation with tube well water and all irrigation with tube well water in main plot treatments and sewage sludge @ 10 t ha^{-1}, 50% sewage sludge + 50% recommended fertilizers and recommended fertilizer (80 kg N + 30 kg P_2O_5) in subplots. The irrigation with sewage water proved its superiority over irrigation treatments with tube well water in respect of plant height, dry matter accumulation. The nitrogen, phosphorus, potassium content and uptake were superior where all irrigation with sewage water was applied. The pH of the soil decreased with the use of sewage water. EC, organic carbon and micronutrient content of soil increased where all irrigation were applied with sewage water compared to where all irrigation were applied with tube well water. Significantly higher fodder yield was recorded where all irrigation were applied with sewage water. Growth parameters, viz., plant height, dry matter accumulation and fodder yield of crop increased with the use of sewage sludge @ 10 t ha^{-1} over control where recommended fertilizer were applied. The total N, P, K content and uptake as well as protein content were significantly higher where sewage sludge @ 10 t ha^{-1} were applied compared to recommended fertilizer. Based on the study it may be concluded that the application of sewage water and sewage sludge led to increase in plant height, dry matter accumulation, and fodder yield. The protein content, organic carbon, N, P, and K increased significantly with the use of sewage water and sewage sludge.

These findings should be considered from the view point of resource management for maximizing fodder yield in sorghum and for long term use of sewage sludge and consequent environmental concerns regarding soil health and sustainability of production system. Emerging biotechnologies involving bio-inoculants may be harnessed to maximize fodder yield as well as mitigating adverse effects of long term use of sewage sludge by microbial degradation of soil pollutants likely to be accumulated through sewage sludge.

EFFECT OF WATER STRESS ON THE PHYSIOLOGICAL AND GROWTH RESPONSES OF MYCORRHIZAL INOCULATED *EUCALYPTUS TERETICORNIS* SM. SEEDLINGS

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Abstract

In winter 2008, an experiment on assessing the effect of mycorrhizal inoculation on growth and physiological parameters of *Eucalyptus tereticornis* Sm. under water stressed condition was conducted at the Department of Forestry, CCS Haryana Agricultural University, Hisar, India. For experimentation, screen house condition approach was adopted. Seedlings were grown with and without mycorrhizal (*Glomus mosseae*) fungus. Young seedlings grown in pots were inoculated with *Glomus mosseae* fungus. *Glomus mosseae* inoculum was mixed with the sterilized potting medium before transplanting the seedlings in the pots. After assuring adequate infection of mycorrhizae in roots, nine months old seedlings were subjected to drought for 17 days by withholding the water to them before reaching to permanent wilting point. Water limitation had significantly increased mycorrhizal infection in eucalypts seedlings. Stressed inoculated seedlings, maintained the significantly higher ($P<0.05$) pre-dawn leaf water potential, chlorophyll and carotenoid contents in leaves, collar diameter, height and biomass than control stressed seedlings. Inoculation with *Glomus mosseae* had also resulted in significantly more periodic increment in collar diameter and height between planting to harvest compared to their respective non-inoculated control plants at harvest. However, proline concentration levels were higher in the stressed inoculated seedlings compared to controls, but not to a significant level. These results suggest that the *Glomus mosseae* greatly assist the eucalyptus plants under water stress and helped in making these effects to a moderate level. These results are more important from the points of view of afforestation in drought prone conditions.

Key words: *Eucalyptus tereticornis*, *Glomus mosseae*, water stress, water potential, chlorophyll, proline

ECONOMIC ANALYSIS OF FARM PRODUCTIVITY WITHIN VARIOUS FARMING SYSTEMS IN A SCENARIO OF DIVERSE LAND DISTRIBUTION LEVEL – A CASE STUDY FROM PAKISTAN

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Abstract

Pakistan inherited feudalism from their Indian and British masters. After sixty years of independence the problem still persists despite promulgation of three formal land reforms. Evidences suggest that the rate of rural poverty is higher (ARIF 2006) than in urban areas and it is strongly correlated with lack of assets in rural areas of Pakistan (ANWAR et al. 2004). Economic development theory illustrates that the rise in land holdings distortions perturb the crop productivity (Vollrath 2006). The study's pivotal objective is to assess the impacts of land distribution disparities on various farm indicators. Three locations were selected within the predominantly rice-wheat farming system within the Indus Basin of Pakistan. The study locations were identified on the basis of varying irrigation endowments: a) irrigated perennial area with year round irrigation, b) irrigated non-perennial area with six months water availability and c) rainfed area without public infrastructure but, mainly, tubewell irrigated. Land distribution was gauged by using simple quintile and Gini coefficient in each study location. However, total and partial factor productivities, cropping intensity, crop diversity etc. were quantified by employing various statistical tools. The results of Gini coefficient exhibited that land was evenly distributed in irrigated non-perennial area as compared to others while rainfed area was found most unequal. It was found that total and irrigation factors productivities were higher in irrigated perennial area while labour productivity was explored as maximum in irrigated non-perennial area as compared to other locations. Furthermore, cropping intensity, crop diversity and yield per hectare of irrigated non perennial area outweighed the other locations. But rainfed area had always minimum values of the respective indicators. Irrigated non-perennial area was significantly better than all of the comparative study locations for most of the indicators. Based on the findings of the study, it is strongly suggested that redistributive land reforms are necessary in land scarce and labour abundant developing countries like Pakistan. It is a key to enhance farm productivity, reduce poverty and food insecurity in the developing nations.

LAND USE PATTERN TOWARDS AGRI-HORTICULTURE, URBANIZATION AND INDUSTRIALIZATION IN RELATION TO SUSTAINABLE DEVELOPMENT AND EMERGING BIOTECHNOLOGIES

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Abstract

India has a total land area of approximately 328 million hectares. Statistical data obtained from different sources have shown that almost 92.7 per cent of the entire area is under actual utilization. Another 22 million hectares have been added to it since the time of independence. As a result, 162 million hectares of land (51%) excels as the net sown area at present. According to the available land use statistics, there has been a slight increase in the net sown area. Almost 28 million hectares have been added over the past few decades. Another 1.3% of the land is under horticulture. The uncultivated lands are subsidiary lands. However, it is noteworthy that the fallow land has declined to 5% from the earlier figure of 7%. Photographic proof, gained from satellites has confirmed that only 46 million hectares come under real forests. A bigger area under forests is an obligation, to maintain the ecological balance and for absorption of carbon dioxide, the assemblage of which is likely to heighten the green house effect. A part of the land that is not utilised is classified as wasteland which mainly includes the baked and rocky deserts, high mountains and uneven lands etc. The growing population and advanced standards of living have resulted in an ever increasing demand for residential land – both, in villages and towns. Besides these, land is needed to develop industry, commerce, transport etc.

In India the per capita availability of land for providing agricultural commodities has declined from 0.48 ha in 1951 to about 0.15 ha in 2000 and it is expected to decline further to about 0.09 by 2050 AD. This calls for maintaining good soil health and other natural resources to produce more food from less and less land and water, often of poor quality, for the survival of mankind and biotic population. In recent years, the negative environmental and social impacts of indiscriminate use of high inputs in agriculture have become increasingly obvious. These realities require agricultural systems that focus as much attention on people as they do on technology, resources, production, and on the long term as well as on short term benefits. Ecosystems management in a wide sense-cropping systems, livestock systems, fisheries, agro-forestry, agro-horticulture, combinations of main and complementary enterprises into integrated farming systems, value addition, recycling of products and farm wastes, combination of organic and less chemical intensive methods and interaction with the surrounding ecosystems – requires both natural resource management and policy management.

With the advent of biotechnology, transgenic crops, mainly Bt Cotton, are grown over about 6.2 million hectares in India. Land use patterns are likely to change in future due emerging biotechnologies for designer crops, nutraceuticals and biovaccines. Since the total availability of land is a fixed asset, it calls for judicious land use planning for various purposes. For sustainable development in all sectors, it would be imperative to enhance agricultural production using contemporary and sustainable farming systems, while maintaining natural resource base, plan urbanization and industry in such a way that synergy in land use is ensured while striking, ecological and economical balance amongst diverse use of land.

SOCIO-ECONOMIC ASPECTS OF SUSTAINABLE LAND USE

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Abstract

During the last few decades global agricultural production has increased considerably. This increase has been accompanied by adverse effects on the resource base of agriculture. Land has been degraded by erosion, salinization, desertification and fertilizer and pesticide pollution. Worldwide some 50 percent of the soil is moderately or severely affected.

The degree of land degradation varies according to different property and production systems. Under the private property regime a clear distinction between different size groups is noticeable. Small holder producers tend to apply environmentally sound methods as compared to most large estates that pursue mechanized monoculture and apply indiscriminately chemical fertilizer and pesticides which foster land degradation.

A state property system has the disadvantage that land use policies are difficult to enforce, as in the case of state forests, the central authorities are often unable to coordinate and control resource use. Under a common property regime land use rights are allocated by local chiefs according to individual abilities. When the society maintains authority over the resource common property is managed in a sustainable manner. However, when national policies usurp local traditions or when local customs break down incentives for resource preservation are often destroyed leading to unsustainable land use practices. In a system of open access to land every potential user has unlimited access to resources. This system leads frequently to overgrazing, excessive fuel wood collection and over extraction of water.

Inadequately defined or non-existing property rights over environmental resources are one of the main reasons for non-sustainable land use.

The paper describes different forms of land degradation and provides estimates about their extent. It analyses the main reasons for land use changes, such as the introduction of modern agricultural machinery, the demand for non-food agricultural commodities, rural poverty, land settlement and conversion of arable land for urban and industrial development.

The role and responsibilities of governments in promoting sustainable land use practices through legislation, regulations and incentives is scrutinized. The influence of subsidies is reviewed and emphasis is given to agricultural supporting services like agricultural extension, access to credit and the promotion of group activities. The paper addresses measures of how to promote sustainable land use, such as Integrated Pest Management, Integrated Plant Nutrition Systems, No-Till/Conservation Agriculture, organic farming, use of indigenous knowledge and the introduction of renewable energy sources.

As the prevention of further deterioration of land resources has to be tackled at the local level the paper reviews also the role of other actors and stresses the need for democratic, accountable rural institutions and the involvement of social networks, farmers' organizations and NGOs. It ends with an appeal to measures and activities which have to be undertaken for achieving the objectives of sustainable land use.

INFLUENCE OF RHIZOSPHERE BACTERIA OF AFRICAN OIL PALM *(ELAEIS GUINEENSIS)* ON CALCIUM, IRON, AND ALUMINUM PHOSPHATE IN VITRO MOBILIZATION

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Introduction

Phosphorus is one of the major factors limiting crop production on many tropical and subtropical soils. Cameroonian soils are mostly acidic causing a strong phosphorus fixation by iron and aluminum. This process decreases also the efficiency of mineral P fertilizers. Rhizosphere microorganisms like mycorrhizal fungi and associative bacteria can improve the use of soil and fertilizer phosphate by plants on soils with strong P fixation (DEUBEL and MERBACH 2005). This study characterized the P mobilizing ability of rhizosphere bacteria isolated in the rhizosphere of African oil palm, one of the most important oil plants in African and Asian countries, with the final aim to select efficient strains as potential biofertilizers.

Methodology

Bacterial strains were isolated from rhizosphere-soil samples as well as from root-fragment samples of oil palm *(Elaeis guineensis)* cultivated in four provinces of Cameroon (Centre, South, South-West and Littorial). To evaluate the solubilization rate of the obtained isolates, diameter of colonies and halo zones were determined on modified nutrient-agar plates (SuBBA-RAO 1982) containing dye (bromo cresol green) and either $Ca_3(PO_4)_2$, $FePO_4 \cdot 2\ H_2O$ or $AlPO_4 \cdot H_2O$.

Twenty strains with halo zones not only on calcium phosphate, but particularly on iron and aluminum phosphate were chosen for quantitative tests in liquid culture. Bacteria were grown in 50ml of Reyes basal medium (REYES *et al.* 1999) with 30 mM of P as $Ca_3(PO_4)_2$, $FePO_4 \cdot 2\ H_2O$ or $AlPO_4 \cdot H_2O$ at 28 °C on a rotary shaker at 150 rpm. After 3, 5 and 7 days pH and P concentration of the solutions were measured.

For determination of carboxylic acids, nutrient solutions of the most efficient strains were centrifuged and separated into neutral, alkaline and acidic compounds with ion exchange chromatography after 7 days of bacterial growth. The acidic fraction was quantified by HPLC (DEUBEL *et al.* 2000).

In order to determine the influence of pH on the solubility of the three phosphates, $Ca_3(PO_4)_2$, $FePO_4 \cdot 2\ H_2O$ and $AlPO_4 \cdot H_2O$ were shaken in HCl and NaOH of various concentrations (0-20 mM) for 90 min. Thereafter, pH and soluble P of the solution were measured. In addition, the mobilizing effect of 0-10 mM of single isolated carboxylates at pH 4 and pH 7 were determined.

Results and Discussion

All strains released significant amounts of P from $CaS(PO_4)_2$ in a range of 1 up to 10 mM. Interestingly, the most efficient strain showed large halo zones on iron and aluminum phosphate, but did not form zones on calcium-phosphate agar plates. Calcium-phosphate solubilization was combined with a pH decrease in nutrient solution.

$AlPO_4 \cdot H_2O$ was also mobilized by all strains (up to 3 mM P). Seventeen strains increased the solubility of $FePO_4 \cdot 2\ H_2O$ significantly (up to 2 mM P). The pH of nutrient solution

decreased more than in treatments with calcium phosphate (down to 4.0-3.5 in single strains), but without correlation with P release.

The most efficient $Ca_3(PO_4)_2$-mobilizing strains produced large amounts of citrate and tartrate and some malate. Most important carboxylates in iron and aluminum solubilizing strains were tartrate and malate. In some strains, also xylonate and gluconate was observed as well as small amounts of citrate, fumarate and trans-aconitate. Carboxylate production could be underestimated by precipitation of insoluble metal compounds.

In additional tests, the solubility of calcium phosphate increased exponentially with decreasing pH. The solubility of iron phosphate decreased with a pH decrease down to 4.5-3.5. Aluminum phosphate showed the lowest solubility between pH 5.5 and 4.5. At pH 3.5 it was comparable with pH 7. Hence, acidification cannot be the explanation for P mobilization in bacterial culture in the last two cases.

At a low pH, all identified carboxylic acids solubilized $Ca_3(PO_4)_2$ with different efficiency. This explains P-release in *in vitro* cultures. However, sparingly soluble calcium phosphates occur only in neutral and alkaline soils. A strong pH decrease is impossible under well-buffered soil conditions. At pH 7, only citrate solubilized remarkable amounts of calcium phosphate. Tartrate and trans-aconitate had a slight effect. Therefore, especially citrate producing microorganisms should be selected to improve P availability on alkaline soils or in case of fertilization with rock phosphate.

Iron and aluminum phosphate were mobilized at pH 4 (corresponding to their natural occurrence) by citrate, malate, tartrate, on a much lower level by gluconate and trans-aconitate. These findings agree very well with the carboxylic-acid pattern of most efficient P-mobilizing strains.

Conclusions

In vitro calcium-phosphate mobilization was caused by acidification of the nutrient medium and the production of different carboxylic anions. Under highly buffered soil conditions (neutral or alkaline pH), only citrate can release remarkable amounts of P from $Ca_3(PO_4)_2$. Citrate can prevent halo zones on calcium-phosphate agar by precipitation of calcium citrate. This effect reduces the use of such plate tests remarkably!

Down to a pH of 3.5, solubilization of iron and aluminum phosphate cannot be explained by proton release. These phosphates are efficiently mobilized by citrate, malate and tartrate. Common plate tests can fail to detect really effective P solubilizing strains. Therefore, liquid culture or genetic characterization are more reliable methods to elucidate citrate, malate and tartrate producers.

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CHARACTERIZATION OF ELITE WHEAT GENOTYPES BASED ON PHYSIOLOGICAL, QUALITY AND BIOCHEMICAL PARAMETERS

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Abstract

Wheat *(Triticum aestivum L. em. Thell.)* is the world's second most important staple crop. In India it is cultivated in an area of 25.5 million ha with a production of 73.03 million tons. Crop varieties are identified and released not only after a thorough assessment of their value of cultivation and use (VCU), but also in the context of Intellectual Property Rights, characterization of varieties based on various morphological traits is essential. Therefore, eighteen wheat genotypes developed at JNKVV, Jabalpur, were characterized on physiological, quality and biochemical parameters. Genotypes were grown during rabi 2006-07 at Seed Breeding Farm, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, in a randomized block design with three replications.

Two physiological parameters i.e. dry matter (DM) production & partitioning and leaf area index (LAI) exhibited significant difference among the genotypes. The genotype MP 3222 accumulated higher amount of DM in ear-heads, whereas genotype MP 3097 possessed a very higher magnitude for LAI at ear emergence time.

Similarly the seven quality tests were performed for estimation of composition of whole wheat (Gluten, Sedimentation value, Protein content, Moisture content, Carbohydrate content, ash percent and hectoliter weight) also varified. The moisture content varied from 8.72 to 13.18 percent, whole meal ash content varied from 1.53 to 2.43 percent, Carbohydrate varied from 68.25 to 76.33 percent, Protein content varied from 10.32 to 12.67 percent, Wet gluten varied from 22.89 to 39.19 percent whereas Dry gluten varied from 10.71 to 15.88 percent, Sedimentation value ranged from 25.00 ml to 40.66 ml and hectoliter weight ranged from 68.58 kg hl^{-1} to 81.50 kg hl^{-1}.

Out of four biochemical tests conducted, two were found polymorphic (Phenol and HCL) and were found effective for discrimination of wheat genotypes, whereas differential response of the wheat genotypes was observed to 2,4-D and Clodinafop (herbicide). Herbicidal sensitivity recorded as susceptible and resistance was recommended for verification of cultivars.

Thus above findings will help to a great extent in maintenance breeding, quality seed production, seed certification and seed testing programmes. It can also be used for screening of genotypes for quality and high yield.

GANDHIAN PERSPECTIVE ON PEACE AMONG DIFFERENT CASTES AND RELIGIONS WITH SPECIAL REFERENCE TO THE DALIT MOVEMENT IN INDIA

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Abstract

The general situation in India has undergone serious changes and ominous and frightening portents have developed raising basic questions about the status of Dalits and various forms of conflicts, which continue to send shock waves across Indian society. Mahatma Gandhi toured interior India and proclaimed a sociological theory that “if the villages perish, India will perish too”. The cancerous growth of communalism has visibly eaten away precious parts of the body. Hence, integration of the mind, body and soul of the nation has to be promoted to deliver the message of peace and love.

By the concept of Sarvodaya, Gandhi really means universal uplift or the welfare of all men and not just the welfare, or greatest happiness, of the greatest number. The struggle of the Dalit Movement could be interpreted as the struggle of the Sarvodaya Movement, promoting welfare of all in the country.

The process of assimilation in Indian society is the crux of the problem. Mahatma Gandhi emphasized assimilation by rejecting any violent struggle. As an alternative, he advocated a non-violent struggle and resisting injustice. Similarly, B.R. Ambedkar worked against injustice wherever it existed. His slogan was: “Educate, organize and agitate.” Justice to the minority will ultimately bring peace to the majority. In this context, the influence of Mahatma Gandhi on Dr. Martin Luther King in his fight against injustice may serve as a model for peace and tranquility through non-violent means.

The Constructive Programmes designed by Mahatma Gandhi, in particular Communal Unity and Removal of Untouchability, may be the foundation of the construction of an ideal society, Satyagraha and fasting constitute its imperishable pillars. Ultimately, assimilation becomes the roof of the society and resistance may alter it. Satyagraha without constructive work is like a sentence without a verb. They are known as two branches of a tree. Above all, Truth and Non-violence are the seeds of assimilation.

The underprivileged groups including Dalits need to bridge the gap and assimilate in normal life as well as resist against injustice. Equally, the responsibility of assimilation lies with the majority. The World today, in particular India, continues, however, to stand on the brink of tremendous peril to which Gandhi holds the key and offers a radical solution.

SUSTAINABLE TOURISM TO REVITALIZE REGIONAL ECONOMIES IN MONGOLIA

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Abstract

In 21st Century, the environmental and ecological conservation of the Earth's systems are urgent global issues, in which forest conservation has the first priority for sustainable eco-system management. In developing countries, forests have been seriously deforested and disturbed, resulting in soil erosion, loss of diversity, and decreased water-holding capacities. As a result, plant productivity has decreased and forest fires occur more frequently, leading to decreased carbon storage and accumulation in ecosystems, and greatly increased carbon emissions. The governments of many countries have been trying to establish new systems and rules for forest conservation. These systems and rules have largely been ineffective however, because of the difficulty in including local people in these kinds of governmental projects. As local people need natural resources to live, a harmonized system of natural resource management is required. Therefore we propose to develop a new forest management system, which are revitalize by Sustainable Tourism.

Key Words: Ecotourism, Education Center, Non-for-Profit organization, Sustainable tourism, Wild fire

OPTIMIZING LAND USE AND ENHANCING CHICKPEA YIELD THROUGH SEED RATE AND FERTILITY LEVEL VARIANTS

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Abstract

Pulse crops play an important role in Indian agriculture and as an integral component of Indian diet, hence Indian economy. In India pulses are grown largely on marginal and sub marginal soils. Chickpea, among pulses, occupies major area .However; chickpea yields are relatively low and can be enhanced through optimized use of inputs. Judicious combination of variety, seed rate and nutrient management are important factors for maximizing yield through synergy of responses. Therefore an experiment was conducted to evaluate the effect of seed rates and fertility levels growth and yield of bold seeded chickpea (*Cicer arietinum*) variety HC 3, at CCS Haryana Agricultural University research farm. The soil of the experimental field was sandy loam, low, medium and high in available, nitrogen, phosphorus and potash, respectively. The pH of the soil was 8.0 with EC 0.93 dSm^{-1}. The experiment was laid in factorial Randomized Block Design with 15 treatment combinations comprising three seed rates (60, 80 and 100 kg/ha) and five fertility levels i.e. combinations of N+P+K at the rate 15+30+20; 20+40+30; 25+50+40; 30+60+50 kg/ha and a control (no NPK). All other agronomic practices were performed as per recommendations. The seed and biological yield increased significantly with increase in seed rate up to 80 kg/ha. At this seed rate crop geometry and crop phenology as well as harvest index was optimal. Likewise, both grain as well as biological yield coupled with high harvest index increased significantly with increase in fertilizer doses up to 25 kg N+50 kg P_20_5 + 40 kg K_2O per ha and thereafter the increase was non significant. The favorable effect of increased level of fertilizers and seed rates on yield and its attributes in chickpea might be ascribed to the judicious use of land space, soil-water and the availability of sufficient quantity of essential nutrients like nitrogen, phosphorus and potash.

FROM FUNCTIONAL GENOMIC RESEARCH TO BREEDING TO IMPROVE THE DROUGHT TOLERANCE OF WHEAT

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Abstract

Drought is one of the most important abiotic stress factors and depending on the season, it can seriously limit wheat production. Breeding for drought tolerance is becoming a more and more important challenge in case of crop plants, notably in wheat. The breeding process includes the characterization of the basic breeding materials in aspect of performance under well-watered and drought stressed conditions. In our experiments we set up a complex stress diagnostic system in the greenhouse of the Cereal Research Non-profit Limited Company where we could analyze the responses of different wheat cultivars to drought. Wheat plants were grown under ideal water regime (watering to 60% of the 100% soil water capacity) and under drought stress conditions (watering to 20% of the 100% soil water capacity). The effect of water withholding on plant growing was tracked by a digital imaging system on the basis of number of plant pixels. After harvesting, plant heights, spike lengths, grain numbers and total grain weights were measured and values of well-watered and stressed plants were compared. Among the pre-selected 14 winter wheat genotypes/varieties significant differences were registered. The methodological details and the results will be discussed summarizing the most important data.

Production of transgenic plants carrying genes that theoretically provide protection under drought condition (candidate genes) is a new approach for improving drought tolerance. The functional analysis of genes will serve new approaches in breeding of wheat. Aldose reductase (*ALR)* and ferritin (*Fer*) genes isolated from alfalfa and salt and cold induced gene (*SACI*) derived from wheat have been used in wheat genetic transformation experiments. Immature embryos of spring wheat (*Triticum aestivum*) cultivar “CY-45” line were used in transformation (PDS-100). Bialaphos selection was used in selection experiment. The protective functions of the alien genes were determined by different stress treatment of control and transgenic lines. In evaluation a complex stress diagnostic system installed in greenhouse and laboratory is used for characterizing of transgenic, selected and improved wheat genotypes. These genotypes under drought stress have significant quantity green mass and yield production comparing to the control. Depending on the transformation event the genes under tests showed positive data to improve drought tolerance of wheat in our functional genomic research.

LAND USE SYSTEMS AND RURAL POVERTY IN GEORGIA

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Abstract

Georgia is a country with high agricultural potential, favourable climatic conditions, and a large share of agricultural land (43%) of which 70% are arable or planted with perennials. In spite of beneficial conditions, the Georgian agriculture suffers from rural poverty and ineffective land use, which is partly due to political circumstances. In the Soviet period, all agricultural land belonged to the central government. After independence in 1991, the land was redistributed by a land reform that included the establishment of a legislative framework for a new land market. Main reform targets were the creation of two types of ownership: (i) private ownership with small surfaces up to 1.25 hectares, and state-owned land for leasing to agricultural enterprises. These two ownership types generated a subsistence sector for family farms and a market-oriented sector with large leaseholders.

Today, one-quarter of agricultural land is privately owned by rural households, and three-quarter are state-owned with half of the area leased out to few large agricultural enterprises. The small one-hectare areas of private farms are further split up into several plots, while agricultural enterprises dispose over average surfaces of 110 hectares with a mean fragmentation into three plots. These enterprises suffer from the high degree of de-mechanization resulting in over 50% of uncultivated leased land.

The fragmentation of private farm land into small plots results in lower productivity impeding commercial agriculture. However, family farms contribute the highest share to the Georgian agricultural output, but lack input supply, marketing channels, processing facilities, extension, and finance. How can land use and socioeconomic conditions of family farms be improved? To this end, I suggest three strategies:

(i) State-owned surfaces should be privatized
(ii) Production of high-value ecological niche products
(iii) Creation of service cooperatives for credit, input supply and marketing

GENETIC RESOURCES PROVIDED BY GENETIC ENGINEERING

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Abstract

Crop plants created for human or animal consumption by molecular biological techniques are referred as GMO's (genetically-modified organisms). Genetic engineering can create plants in the laboratory with desired trait(s), e.g. increased resistance to herbicides, weather extremes (droughts, cold) or enhanced nutritional value (protein/sugar content, etc.). This process is much faster than conventional breeding methods (WHITMAN, 2000). During genetic modification, the intended gene is built-in the genome of the plant with the help of a vector that contains other genes, e.g. viral promoters, transcription terminator elements, genes of antibiotic resistance and reporter genes (PUSZTAL et al., 2003).

In 2020 an estimated 8 billion people will live on earth, which will mean massive changes in the production, distribution and stability of food products. With no doubt, new methods in production are needed to feed the increased population of the planet. GM crops could significantly improve crop yields because more food can be grown on less land area. An environmental fact is that after the first some years of using herbicide tolerant GM soybean, seed rape, cotton, corn varieties and insect protected GM cotton, a dramatic reduction of pesticide use was observed (in 2000 total global reduction in pesticide use was 22.3 million kg of formulated product. Can significantly decrease their effect on water quality through run off and leaching of residues into surface and groundwater. To date, the only type of GMO grown in the EU is *Bt* corn. *Bt* corn contains a gene from a bacterium *(Bacillus thuringiensis)* that produces a toxin (*Bt*-toxin) to defend it from the European corn borer *(Ostrinia nubilalis)*. The insect pest is present primarily in southern and middle Europe, and is slowly making its way north. Genetically-modified crops are grown in six countries of the European Union and their cultivation areas are increasing. In *Spain*, a significant amount of the corn production is genetically modified - an estimated 25% of the current production. *Bt* corn was first grown in 1998. In *France*, biotech corn has gained strong support among the farmers, who stand to gain more from the crop than any other EU country. *Bt* corn was first grown in the *Czech Republic* in 2005. *Portugal* also began producing *Bt* corn in 2005. Since the 2006 growing season, *Bt* corn cultivars have full approval in *Germany* and are now ready for commercial cultivation. *Slovakia* became the newest country in 2006 to plant biotech crops. The approach to genetic modification in plant breeding and the coexistence of traditional and biotech crops is not uniform all over the world. While in the U.S. the ratio of the GM-production reached 30-40%, from which it made no longer sense to differentiate between GM and conventional, in Europe there is great resistance to the new technology. In Hungary the possible future application of GM plant is promising and hopefully will provide benefits to farmers from environmental, ecological and economical point view.

GENETIC RESOURCES PROVIDED BY GENETIC ENGINEERING

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Abstract

Crop plants created for human or animal consumption by molecular biological techniques are referred as GMO's (genetically-modified organisms). Genetic engineering can create plants in the laboratory with desired trait(s), e.g. increased resistance to herbicides, weather extremes (droughts, cold) or enhanced nutritional value (protein/sugar content, etc.). This process is much faster than conventional breeding methods. During genetic modification, the intended gene is built-in the genome of the plant with the help of a vector that contains other genes, e.g. viral promoters, transcription terminator elements, genes of antibiotic resistance and reporter genes. The three generations of genetically-modified (transgenic) plants belongs to i) abiotic and biotic stress resistance, ii) modification of physiological processes and iii) production of special molecules: bioreactors. In 2020 an estimated 8 billion people will live on Earth, which will mean massive changes in the production, distribution and stability of food products. With no doubt, new methods in production are needed to feed the increased population of the planet. GM crops could significantly improve crop yields because more food can be grown on less land area. An environmental fact is that after the first some years of using herbicide tolerant GM soybean, seed rape, cotton, corn varieties and insect protected GM cotton, a dramatic reduction of pesticide use was observed (in 2000 total global reduction in pesticide use was 22.3 million kg of formulated product). Reduced use of pesticides can significantly decrease their effects on water quality through run-off and leaching of residues into surface and groundwater. Deployment of insect resistant Bacillus thuringiensis (Bt) varieties was estimated to have reduced the total world use of insecticides by 14%. Plants could be modified directly to be used for environment preservation purposes, such as: Phytoremediation: removals of pollution from the environment with the help of plants, e.g. poplar trees have been genetically engineered to clean up heavy metal pollution from contaminated soil. Phytoextraction (or phytoaccumulation) uses plants to remove contaminants (heavy metals) from soils, sediments or water into harvestable plant biomass. Phytostabilization focuses on long-term stabilization and containment of the pollutant. Mainly focuses on sequestering pollutants in soil near the roots but not in plant tissues. Pollutants become less bioavailable and livestock, wildlife, and human exposure is reduced. An example application of this sort is using a vegetative cap to stabilize and contain mine tailings.In contrast with the possible advantages of GM plants there are a lot of potential risks; among these the most important is coexistence, e.g. in case of the first generation transgenic plants The paper reviews GMOs produced in USA, Europe and elsewhere in light of their perspectives and challenges.

BIODIVERSITY POLICIES WITH OUTLOOK TO HUNGARY

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Abstract

According to the Convention on Biological Diversity, the definition of *biodiversity* is "the variability among living organisms from all sources, [including] diversity within species, between species, and of ecosystems". Biodiversity is measured by the number of species, which is currently estimated between 5 to 30 million. The distribution of biodiversity depends on a lot of factors, such as climate, altitude and soil. Diversity is higher in tropical regions and lower approaching the polar ones; higher on land than in the oceans (the most species rich animal class, insects, lives on land).

The preservation of biodiversity is an increasingly important public policy issue, since the variation in organisms is severely threatened. The rate of species extinction has increased rapidly in recent years to over one hundred times the historic average, which gives reasons for pessimism. Biodiversity is crucial for the survival of mankind: a wide variety of species for food production and medical research is needed. Ecosystems also need biodiversity for their normal functions; they take part in the regulation of climate that provides air, water or oxygen.

Hungary, as a Member State, has to follow the guidelines and restrictions of laws made by the European Union. The Hungarian Parliament also declared that nature protection is an important aim and has to be regulated.

The National Nature Conservation Master Plan is not only a part of the National Environmental Program, but is also organically connected to other national plans and strategies, and determines the related sectoral policies.

The implementation of these plans greatly influences the status of nature, thus they must represent the interests of nature conservation in an integrative way, constituting an organic system.

Hungary's flora and fauna are very rich and have significant biodiversity. This uniqueness resulted in the formation of a special Hungarian biogeographic region, the Pannonicum, with various types of rocks, formed in different geological eras under different formation conditions, karst areas stand out among the geological and geomorphological resources. There is wide variety of habitats and wildlife with "protective forests", lowland and hilly area grasslands, nature-like floodplains along our large rivers, traditionally used meadows, vineyards and orchards in hilly and mountainous regions, traditionally cultivated rotation farming areas, and peculiar natural landscapes of unique beauty. Unfortunately, and as a familiar global trend, agricultural practice destroyed several wetland habitats like moorlands, fern woods, gallery forests, etc. 9.2% of Hungary's territory is protected by separate decrees. The concept of biodiversity preservation and natural protection is very important in global levels, because with the increasing material needs, habitats of several species are constantly shrinking and destroyed, and this leads to the decline in numbers of both species and their different habitats. Strict international and national laws exist with fines or penalties for anyone act against them. Activities without borders can be observed – and their number is increasing – all over the world to protect threatened and endangered plants and animals. Governments and non-governmental organizations feel the need of education to develop right attitude toward nature conservation.

EFFECTS OF BIOFERTILIZER, FARMYARD MANURE, NUTRIENTS AND PLANTING DENSITY ON PRODUCTIVITY OF RAIN-FED PEARL MILLET (PENNISETUM GLAUCUM L.)

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Abstract

Low rainfall, high temperature, low water holding capacity, nutrient deficiency and poor microbial activity are major factors contributing to low crop productivity and profitability in rain fed agriculture. Integrated nutrient management and crop selection can offer an effective strategy to mitigate these problems to considerable extent. Pearl millet (*Bajra*) can be a right choice as it is mainly grown as rain fed with little extra inputs.

Experiments were conducted, under ACRIP including ORP, to evaluate the role of integrated nutrient management under rain fed conditions (5 years) and nutrient management and planting density under water deficit conditions (2 years). The results revealed that integrated use of farmyard manure (4t/ha), seed inoculation with Azotobacter and 20 kg Nitrogen + 10 kg P_2O_5 was at par with 40 kg N + 20 kg P_2O_5. It was interesting to note that seed inoculation with *Azotobacter* gave additional income of Rs 533 over 20 kg N/ha with additional cost of Rs.5/ha. Also, considerable saving of mineral fertilizers can be achieved through the use of *Azotobacter* and FYM.

The results of experiments conducted split plot design over two years under water deficit conditions revealed highest pooled grain yield by HHB 67-2. Application of 60 kg N + 30 kg P_2O_5 ha^{-1} resulted maximum pooled grain and stover yield at par with 90 kg N + 45 kg P_2O_5 ha^{-1}. Sowing pearl millet at 45x12 cm spacing fetched highest pooled grain and stover yield. HHB 67-2 had significantly higher total uptake over HHB 67. 60x12 cm spacing had higher NPK content but 45x12 cm resulted into higher total uptake of NPK. NPK content and uptake was found higher when pearl millet was fertilized with 90 kg N + 45 kg P_2O_5 ha^{-1}. Pearl millet hybrid HHB 67-2 recorded relatively higher value for consumptive water used and water use efficiency. It is recommended that to maximize productivity in rain fed pearl millet judicious combination of crop genotype, biofertilizer (*Azotobacter*), FYM, nutrient doses and crop geometry should be considered important to harness the benefits of integrated nutrient management and water use efficiency.

LAND AND WATER USE EFFICIENCY IN SOYBEAN SEED PRODUCTION SYSTEMS IN INDIA: PROBLEMS AND PROSPECTS

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ABSTRACT

Land and Water are the two natural resources whose availability is decreasing very fast around the world as well as in India at higher decreasing rates due to fast increased population growth, urbanization as well as more water requirement for fast increasing population. This has reflected in decreased availability of land for agriculture as well as quality seed production systems. Several areas have been identified in the country for quality seed production in India but there is no possibility for area expression under seed production due to limitations. Hence, it is essential to improve the seed multiplication of ratio's, using reduced rates of quality enhanced seed, high seed recovery during processing cost reduction investment on essential and important input seeds has been the top of agenda. Soybean varieties have been developed with narrow genetic base resulted in very slow progress in productivity over few decades in India.

The sustainable production largely depends upon breeding, agronomical, physiological, plant protection and seed quality enhancement technologies. All these components play a vital role in enhanced productivity in soybean. Erratic monsoon, inadequate water management imbalance of nutrients, lack of diversification, disease and pest incidence, lack of multiple disease resistant varieties with very poor seed replacement rates have been major constraints of soybean production in India These can be addressed through development of multiple disease resistant varieties supported by seed production systems through land and water management technologies that can do well in all types of soils. Multiple disease resistant varieties quality enhanced seeds must be planted at the rate of 50 kg/ha in case of early maturing varieties, 40 kg/ha in case of medium maturing varieties in seed chain on raise bed through ride bed planter. This method of planting provide high seed multiplication rates, very good quality seeds for field establishment, germination and seedling vigour as well as high seed recovery during the processing. Incidence of biotic stresses i.e. disease and pests will be extremely low as well as abiotic stress will be almost negligible.

Varietal replacement of soybean is very fast in India but the replacement of farmers saved seed with the certified seed is extremely low for the last many years. The high yielding potential of certified seed of soybean as compared to the farmers saved seed is very well demonstrated in Madhya Pradesh. The situation is improved due to seed cooperative societies, resulting in higher seed replacement rate to the extent of more than 30% to enhance the productivity levels of soybean in Madhya Pradesh as well as in Maharashtra. The conscious seed production had definite advantages including creating seed demands and also assures the faster varietal replacement in India.

Soybean seeds of assured quality can be expected to respond to fertilizers and other inputs and varieties are grown under different environmental influences with regards to the ecological conditions. JNKVV had released potential genotypes viz. JS 335, JS 93-05, JS 95-60 and JS 97-52 for cultivation with the coverage of more than 80% of the area in the country. These lines are having resistance to few multiple adverse environments and also for biotic stresses. The improvements of seed quality either through breeding for better seed vigour and viability or through an integrated approach combining suitable, harvesting, threshing, drying and processing methods with seed treatments and halogenations to enhance and maintain seed quality till sowing, will help in sustaining the soybean yields in the tropics.

EFFICIENT MANAGEMENT OF MICRONUTRIENTS DEFICIENCY TO SUSTAIN FOOD GRAIN PRODUCTION IN PUNJAB, INDIA

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Abstract

Punjab is a little big state of India: little because the state occupies only 1.5 per cent of the geographical area of the country and big because around two-third of the food grains procured annually in India come from Punjab. Food grain production, no doubt, increased tremendously to 230 million tons in 2007-08 and made the country self-sufficient in food grain production, yet it resulted in the faster depletion of the finite micronutrient reserves of soils. The adoption of rice-wheat system particularly in the non-traditional rice growing areas has resulted in the over-exploitation of the natural soil resource base and this trend has been enhanced by the imbalanced use of inputs. The increased use of poor quality irrigation water to meet the water requirement of this cropping system has further aggravated the problems of micronutrient deficiencies. The soils of the south-western districts of the State are more prone to micronutrients deficiency as compared to central and sub mountainous districts. Further, soils which are coarse in texture, low in organic matter and high in pH and $CaCO_3$ are more prone to micronutrients deficiency. Recent survey of soils samples using GPS indicated that 22, 12, 11 and 2% soils of Punjab are deficient in Zn, Fe, Mn and Cu, respectively.

Among the micronutrients, deficiency of Zn is the most widespread. Soil application of $ZnSO_4.H_2O$ at the rate of 40 kg/ha have been found to be efficient and economical for correcting Zn deficiency in rice and this dose is also sufficient for meeting the Zn requirement of the following 2-3 crops. Soil application of zinc sulphate increased the average yield of cereals by 3.4 to 9.5 q/ha. Iron deficiency is acute in rice grown on coarse textured soils newly brought under cultivation. Deficiency of Fe in rice grown on sandy soils can be combated efficiently with 3-4 foliar sprays of 1% $FeSO_4.7H_2O$ solution at weekly intervals. Regular incorporation of *Sesbania aculeata* green manure every year before transplanting rice can also help in ameliorating Fe deficiency. Depending upon soil conditions, the response of rice to foliar application of ferrous sulphate ranged from 2 to 73 q/ha. For correcting Mn deficiency in wheat, $MnSO_4.H_2O$ proved more efficient than MnO_2 and other multi-micronutrient mixtures. Three to four foliar sprays of 0.5% $MnSO_4.H_2O$ solution initiated before the first irrigation proved more effective and economical as compared to soil application of Mn. *Durum* wheat varieties are more susceptible to Mn deficiency and should not be cultivated on Mn deficient soils. Average response of wheat to foliar sprays of manganese sulfate ranged from 2.0 to 29.5 q/ha. Limited information is available on emerging deficiency of B and Cu in State and on response of different crops to application of Cu and B in deficient soils.

CLIMATE CHANGE AND ITS IMPACT ON BANGLADESH AGRICULTURE

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Abstract

South Asia is the most vulnerable region of the world to climate change impacts. Bangladesh ranks high in the list of the most vulnerable countries on earth. Bangladesh's high vulnerability to climate change is due to a number of hydro-geological and socio-economic factors that include: (a) its geographical location in South Asia; (b) its flat deltaic topography with very low elevation; (c) its extreme climate variability that is governed by monsoon and which results in acute water distribution over space and time; (d) its high population density and poverty incidence; and (e) its majority of population dependents on crop agriculture which is highly influenced by climate change. Despite the recent strides towards achieving sustainable development, Bangladesh's potential to sustain its development is faced with significant challenges posed by climate change. It is therefore of utmost importance to understand its vulnerability in terms of population and sectors at risk and its potential for adaptation to climate change.

Bangladesh is already evidencing the adverse impacts of global warming and climate change. The following impacts have been observed. Summers are becoming hotter, monsoon irregular, untimely rainfall, heavy rainfall over short period causing water logging and landslides, very little rainfall in dry period, increased river flow and inundation during monsoon, increased frequency, intensity and recurrence of floods, crop damage due to flash floods and monsoon floods, crop failure due to drought, prolonged cold spell, salinity intrusion along the coast leading to scarcity of potable water, coastal erosion, riverbank erosion etc. The projected sea level rise (SLR) along the coastal areas of Bangladesh will be about 88 cm by the year 2100. If this comes true, a majority of the low-lying non-embanked coastal areas may be completely inundated. Saltwater from the Bay of Bengal has penetrated 100 km or more inland along tributary channels during dry season. These changes in the physical system of the country directly affect a number of major productive systems that include (a) crop agriculture, (b) livestock production, (c) aquaculture and fish production, (d) coastal shrimp production, and (e) forest and vegetation.

The agriculture in Bangladesh is highly susceptible to variations in the climate system. The agricultural production would be extremely vulnerable under climate change scenarios, and as a result, food security of the country will be at risk. The economy of Bangladesh especially the agriculture sector needs to adapt to risks/threats caused by climate change.

Rice is by far the most important crop in Bangladesh. Together with the possible reduction in monsoon, rice area (as a result of greater spread of flood waters, and longer duration of flooding) and a reduction in the winter rice area (due to constraints in irrigation); the total area suitable for rice production may in the future stagnate or possibly decrease.

There are 260 species of fish in Bangladesh, all of which are sensitive to particular salt and freshwater conditions. The changes in tidal patterns, as well as increasing saline intrusion into the freshwater rivers, associated with climate change, will impact on fish populations.

Climate change with stronger surge, tidal bores, general rise in surface water will have detrimental effects on coastal shrimp culture.

Livestock suffer large-scale death in cyclonic storm surge. Prolonged flood can also cause death of livestock through a number of direct and indirect diseases. During droughts lack of water will increase livestock's vulnerability to diseases.

The Sundarbans forest, the home of many endemic species including the Royal Bengal Tiger (*Panthera tigris*), will be severely affected under climate change. The mangrove forest depends largely on the freshwater supply. Under climate change induced aggravated low-flow conditions; there might not be adequate quantum of freshwater. It is inferred that poor quality shrubs will dominate with increasing salinity and high-value timber species will gradually disappear.

There are three adaptation options: retreat, accommodation and protection. In view of high population density and shortage of land, retreat is not possible.

Development of drought and salinity tolerant varieties, switching to alternative cropping patterns with respect to altered agro-ecological zones etc. could modify the threat to a significant extent. Good extension programmes would help achieve awareness up to a desired level so that the farmers may respond to the threatening environmental factors. Adequate policy framework and market instruments (technology availability at subsidized rates, credit, etc.) coupled with social engineering processes could facilitate implementation of such measures. In case it becomes extremely risky to continue agricultural activities under an altered climate scenario, an alternative land use (shift in cropping pattern, crop calendar adjustment opting for less susceptible crops etc.) might be considered as the next available option. These initiatives should be supported with awareness building initiatives of the farming communities.

Adaptation potentials are limited by the inherent inefficiencies, lack of foresight in planning for the future, poor coordination among relevant institutions, poor information assimilation capacity and lack of trained and motivated personnel. The central government could not successfully utilize the full potential of the local government and the latter could not assume the full responsibility of implementing local-level planning due to weaknesses in governance system. All these are possible barriers to successful adaptation, which might have direct implications in agricultural sector.

People's lack of understanding might also be considered as a possible barrier. Resorting to alternative livelihood options could be of immense help if understood their merits properly and planned early. Capacity building might be a pre-requisite to enhance people's understanding.

IMPACT OF PHYSIOLOGICAL INDUCED VARIABILITY IN RELATION TO IMPROVEMENT IN YIELD COMPONENTS AND NUTRIENT USE EFFICIENCY IN SOYBEAN

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Abstract

Genetic variability in yield attributes offers an effective selection programme for its improvement. However, it's low magnitude and narrow range present in a breeding population limits the scope of genetic improvements. Studies on physiological factors viz "photo period - day length manipulation" in soybean through physical means (filament light) were found to induce enormous variation particularly in important yield components which can be optimized to better harvest. Experiments were conducted on four commercial genotypes i.e. JS-335, JS- 93-05, JS 95-60 and JS 97-52 which were exposed to additional day length for six hours on 30 days old crop and continued up to fifteen days. Results revealed differential response of genotypes to such treatments in relation to plant height, number of pods and number of branches. The genotypes JS-335 & JS97-52 were observed to exhibit remarkable increase in all the characters (more than 100%) where as JS-93-05, JS-95-60 did not show appreciable change. The present paper deals with method and its implications to enlarge variability in important traits and results are discussed to improve the seed yields and minimize nutrients requirement in soybean.

Keywords: *Glycine max*, photo period, genetic improvement, nutrients use efficiency

STRATEGIES TO DEVELOP SUSTAINABLE APPROACHES AND INTEGRATED FARMING SYSTEM MODELS FOR LIVELIHOOD AND ENERGY SECURITY FOR SMALL LAND HOLDERS IN DEVELOPING COUNTRIES

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Abstract

Integrated farming system as a concept takes into account the components of soil, water, crops, livestock, labour and other resources with farm families at the centre managing agricultural and other related non-farm activities. The farm families function within the limitations of its capabilities and resources, social-cultural settings and interaction of these components with biophysical and economic factors. Integrated farming systems are productive as they encourage habitat conservation, value addition and utilization of products and wastes as inputs in other enterprises within the farm.

Diversification and selection of alternate but complementary enterprises, post harvest management and value addition and marketing would ensure optimization of resources, recycling of farm residues, generation of non-conventional alternate sources of energy, minimizing risks and providing better income and employment is the better option. This would require in depth understanding of the role of various factors of productivity, reorientation of extension services at District, block, *Panchayat* levels, development of infrastructure facilities for value addition and processing of diversified enterprises with adequate support of marketing intelligence to help the farmers and the rural community for their holistic development and welfare.

India has got over 350 million livestock population and vast resources of biomass production on rivers and canal banks, non arable lands and field bunds, domestic wastes and several other sources. Thus there exists an adequate opportunity of energy generation from renewable and non-renewable plant and animal sources to meet the energy requirement of agriculture, industry and domestic purposes in rural areas.

The agricultural production in rainfed agro-ecosystems is characterized by not only low productivity but also lesser stability, greater risks and unemployment, which affect the economic conditions of a large number of small land holders located in fragile and harsher environments. Thus, there is a need of developing agro-technological packages that force on improved productivity, economic stability, equitability, livelihood security for small holders and sustainability of the natural resource base. This paper examines the role of elements of sustainability in integrated farming systems.

LAC CULTIVATION FOR ENVIRONMENTAL AND SOCIAL ECONOMICS IN CENTRAL INDIA

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Abstract

Decline in crop productivity in Mediaraas village, Anuppur, district of Central India, had a direct impact on the decline of household income and in rise crime rate by unemployed youths in the village. Cultivated field transforming to fallow land and *Butea monosperma* being indiscriminately cut for fuel wood further permitted free settlement of Fly ash from Amarkantaka Thermal Power plant in the neighbourhood.

Improving the asset base – both human and natural capital, of the poor – is a critical element in promoting pro-poor sustainable growth. Promotion of Lac cultivation on the naturally occurring *Butea monosperma* that started in the year 2000 with two young farmers in the village on fifty *Butea monosperma* trees expanded to involve over 110 people and over half a million trees in Mediaraas by the year 2008 of Lac – a natural resin of insect origin with wide industrial uses serves as a cash crop to the growers. Lac cultivation raised the annual household incomes to varying levels up to over half a million rupees. Inflow of cash twice a year encouraged conservation of *Butea monosperma*, generation of local employment, investment in agricultural technologies and inputs increasing in crop productivity and cropping intensity. The formation of the Lac growers association for technical and market support has lead to empowerment and gender equity, increased investment in education and health of children, as well as other assets. Conservation of *Butea monosperma,* influencing policy changes and promotion of social harmony in the village are other visible changes that Lac cultivation has brought about.

SIGNIFICANCE OF DIFFERENT CARBON SOURCES ON SHOOT DEVELOPMENT OF MISCANTHUS GENOTYPES

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Abstract

Miscanthus is a temperate perennial cross-pollinating grass used commercially as an ornamental plant. The large biomass production, and the low input of fertilizer needed makes Miscanthus and Arundo donax an interesting potential non-food crop with broad applications e.g. for fuel and energy, for thatching, as fiber for the paper- and car industry and for ethanol production. The species can be vegetatively propagated by rhizome division or by in-vitro propagation by axillary shoots.

In species like Miscanthus sinensis and Arundo donax, which are difficult to multiply by seed and reproductive organs, the development of an efficient in-vitro culture system offers methods for propagation with advantage that a large number of plantlets can be produced with reasonable low costs and can be useful for breeding purposes.

Plant material of 2 different Miscanthus x giganteus origin were obtained from field plants. The plant material was surface sterilized with 80 % alcohol. Axillary buds were placed on a shoot inducing nutrient solution. These medium was a modified MS basal medium (MURASHIGE & SKOOG, 1962) supplemented with 20 g l^{-1} sucrose, and 0,3 mg l^{-1} 6-Benzyl-aminopurin for the shoot induction. In the nutrient solution was the pH adjusted to 5,7 prior to autoclaving. Explants were incubated with a day length of 16 h at 21 °C in glass culture dishes. During the whole culture duration (10^{th} - 60^{th} day, every 10^{th} days) the nutrient content of the culture medium (N, P, K, Ca, Mg) of 2 genotypes were determined by Kjeldahl-method, AAS and photometer.

After 40 days of culturing the axillary buds three times more shoots could be harvested.

The results showed that after 35 days nitrogen and phosphate in the medium were nearly completely taken up. That means from that time on no increase of shoot growth will happen. The nitrate content in the nutrient solution decreased steadily up to the 40^{th} day but stagnated thereafter. This was the same for both genotypes

The phosphate content in the medium of both genotypes has already decreased from the beginning of the culture.

Therefore, phosphate is obviously the limited element of the in-vitro propagation. During the first 20 days potassium, calcium and magnesium was hardly taken up by the plants. However, after that time a slow decrease of these nutrients could be observed. Up to the 60^{th} day the plants had enough K, Ca and Mg for their development.

After the shoot propagation they were transferred into a nutrient solution for root formation. After about 14 days the rooted shoots could be potted in soil.

PROSPECTS OF INTERNATIONAL COOPERATION TOWARDS SEED PRODUCTION TECHNOLOGY OF IMPORTANT FIELD AND VEGETABLE CROPS IN AFRICA WITH INDIAN ALLIANCE

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Abstract

The presentation starts with a brief overview about the highlights of the Indian agriculture and Indian seed industry. Indian agriculture has passed through different stages of revolution i.e. Green Revolution, Hybrid Revolution and Gene revolution. The Indian seed market is worth of 1.06 billion US $ and it is growing at 12 - 13% per annum for the contribution of 4 % of the global seed market. The reasons of the success of Indian seed industry are highlighted, with the context of giving a new direction to the African seed industry. The ever increasing demand for feeding the nation and to meet industrial requirement for brewing, poultry, processed cereals based products and bio-ethanol has opened up tremendous opportunities for this continent. Africa is a richly diverse continent with a wealth of natural resources. Growth of agricultural production has been – for the most part – minimal and yet agriculture remains the backbone of the African economy with improved productivity seen to be an important driver for growth and development i.e. transformation of agriculture in Africa. The African seed industry is still mainly public research oriented either at national level or at regional level. The current seed system of most of the African countries is based on community based seed supplies. The estimated size of national seed market in Africa is around 1000 US $.

The major constraints on African countries are

- Lack of agricultural commodity-organized market and its corollary of dual agriculture commercial and subsistence
- Policy frame work
- Reliable statistics on farming profiles and seed markets
- Market disturbance due to seed donations
- Non level playing field between public and private sector
- Poor infrastructure
- Agriculture extension and education

Researchers, extension staff and other development agents need to know what is there on the ground and what is appropriate within the complex agro-ecological farming systems. The best way to transform agriculture in Africa has to be with the local research institutes as they can go straight to the farmers and they can understand what the farmers need. To make any meaningful gains in agricultural productivity, the most important requirement is policy reforms, to bring about a more effective national agricultural research system and also a more effective extension system. The other ways are to build partnerships i.e. partnerships between scientists, between policymakers, between traders and farmers, so that at each stage people can identify the roles they have to play along the entire chain from production to the market.
The innovation system – bringing actors together to promote action learning and promote value addition along the chain from agricultural research right through to consumption, whilst promoting linkage to markets, linkage to policy issues – is the way forward for us in Africa. African farmers are not to be viewed as a subsistence farmer but as an agricultural

entrepreneur. They make investment decisions, they manage risks and they have to attend to many, many more needs than just the food needs that they have.

The biggest hindrance is the income for growing the agribusiness. So there is a need to see how to link up with developers, how can to link up with the financiers and ensure that there is a possibility to promote this agribusiness for the smallholders. So there is a need to create conducive environment, so that when the technologies are available, farmers can use them to produce, to sell, get revenues and feel happy.

Public Private Partnership (PPP) can be an alternative and the most effective mechanism for translating the potential of agriculture resources into products to enhance agricultural productivity and to improve the economic condition of farming community. Success of PPP depends on the following factors:

- Partnership to be based on common goals of the partners to achieve objectives of mutual interest that are also aimed at addressing national challenges in agricultural growth and farmers' income.
- Appropriate authentication, validation and valuation of the product before it is offered for commercialization.
- The partners to be adequately conversant with benefit sharing and IPR issues.
- Adequate flexibility should exist within the broad framework of operating rules and regulations to address the concerns of each partner.
- Each partner should act faithfully and legitimately to implement the partnership. The partnership should be built on mutual trust and commitment to create a dynamic and result oriented working environment.
- Ultimately, the output of the partnership should be more than the potential of individual partners.
- The partners should actively work towards making the partnership successful rather than terminating it for one or the other reason.

Seed is the most important determinant of agricultural production potential on which the efficiency of other agriculture inputs is dependent. Seeds of appropriate characteristics are required to meet the demand of diverse agro-climatic conditions and intensive cropping systems. Sustained increase in agriculture production and productivity is dependent to a large extent on the development of new and improved varieties of crops and an efficient system for timely supply of quality seeds to farmers.

The major focus areas on PPP in agriculture is collaboration in germplasm development, development of value added traits, joint testing, product placement and market development for new products, co-operation in contract farming of hybrid seed production, extension and human resource development. Consortium approach by International institutes like ICRISAT, IRRI, and AVRDC is one of the successful models of PPP. The major opportunities for PPP in seed sector will be product development then supply chain and extension. Donors can support a regional effort, and bring the partnership into regions where on its own operations would not be profitable. The goal is to establish a sustainable commercial seed industry capable of ensuring that small-scale farmers have affordable, timely and reliable access to adapted genetics and traits in high quality seeds and planting materials.

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