CTA ANNUAL SEMINAR

Closing the Knowledge Gap:

Integrated Water Management for Sustainable Agriculture

Abstracts

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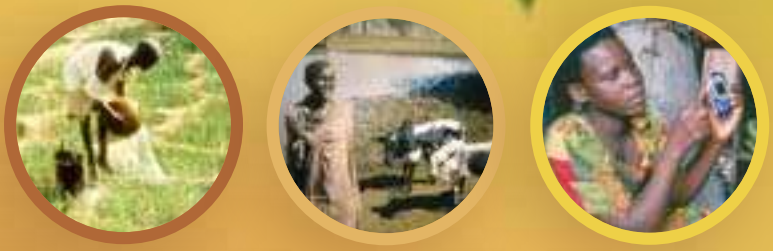

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Tel: +31 317 467 100
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FOREWORD

Closing the Knowledge Gap:
Integrated Water Management for Sustainable Agriculture

In the African, Caribbean and Pacific (ACP) region, agriculture offers a viable opportunity for spurring growth, overcoming poverty, and enhancing food and nutritional security. Through forward and backward linkages, agricultural productivity can stimulate growth in other parts of the economy. It is therefore necessary to not only address constraints specific to the agricultural sector, but also to respond to emerging challenges in other related sectors.

Climate change is already posing major challenges to agricultural producers within ACP through more frequent and intense floods, prolonged droughts, hurricanes and other extreme weather conditions. Agriculture is expected to face more intense water stress as climate variability intensifies.

The potential of agricultural water management has not yet been tapped in most ACP countries, even though, according to FAO, proper irrigation can lead to an increase in crop yields of 100–400%. Investments in agricultural water management will be essential to ensure access to an affordable and reliable water supply. This would be an important first step in enabling many poor, small-scale farmers to boost agricultural productivity, enhance their livelihoods and improve food security.

By focusing on the theme of 'Closing the Knowledge Gap: Integrated Water Management for Sustainable Agriculture' for the annual seminar, CTA and NPCA aim to identify the key information and knowledge needs that underpin policy and strategy decisions that impact on efficient water resource use for improved agricultural productivity and growth in ACP countries. The participants will explore the relevant sources of knowledge and how best it can be shared to improve investments in integrated water management. Ultimately, we hope to identify the technical and policy gaps and develop a strategy on how to close the gaps.

We hope that the reflections and discussions during the week, supported by the presentations and keynote papers, the abstracts of which are contained in this booklet, will stimulate positive actions to tackle water challenges in ACP agriculture.

Michael Hailu
Director - CTA

Dr Ibrahim Assane Mayaki
CEO - NPC

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DR D. MOLDEN, DEPUTY DIRECTOR-GENERAL, INTERNATIONAL WATER MANAGEMENT INSTITUTE (IWMI), SRI LANKA

DOUBLING YIELDS IN THE FACE OF WATER SCARCITY AND CLIMATE CHANGE

Keywords: climate change, food, soil fertility, water resources, water storage

Water scarcity and climate change form a dual challenge to food and environmental security. More food will be required for a growing, wealthier and urbanised population, which will put more pressure on water resources. There is growing concern that climate change will lead to decreased yields in sub-Saharan Africa due to increased droughts and higher temperatures, where 95% of farmlands are rain-fed and where rates of soil fertility loss are alarming. Important pathways to growing enough food with limited water are to improve access to water and improve soil fertility in irrigated and low-yielding rain-fed areas where yields could be doubled or tripled in spite of climate change. In pockets of poverty in sub-Saharan Africa and Asia, expanding access to water through a range of water management solutions holds the key to food security and poverty reduction. Water storage will be particularly important to cope with climate change and more variable rainfall. We need to consider a range of options from ponds and small on-farm reservoirs to groundwater and soil moisture. However, for sustainable water use, agriculture needs to be seen as an ecosystem interacting with other ecosystems. These actions will require serious changes in how we think about water and food, and how we govern water and land resources. The good news is that any actions taken now to improve water security for food production will ultimately help us cope with climate change.

KEYNOTE 2:
PROF. J.N. ELOFF, RESEARCH PROFESSOR AND LEADER, PHYTOMEDICINE PROGRAMME, UNIVERSITY OF PRETORIA, SOUTH AFRICA

SCIENCE, INDIGENOUS KNOWLEDGE AND INNOVATION – CHALLENGES FOR DEVELOPMENT

Keywords: indigenous knowledge, medicinal plants, natural products

The historical interaction between indigenous knowledge, science and innovation and the challenges that had to be faced in the development of medicines will be discussed. The use of medicinal plants from different continents in western herbal medicine will be analysed, as well as the reasons for the underperformance of African medicinal plants and the measures taken to remedy this. The rational use of African plant species has a strong potential to increase the quality of life for people in Africa. There is a disconnection between the funds provided to deliver a large numbers of research papers, PhD and MSc degrees by universities, and the delivery of useful products. This may to be due to the different aims of the major role-players. The current interaction between science and indigenous knowledge will also be discussed, as well as the main factors limiting the innovation and rational use of chemical compounds in plants, especially in agriculture. These factors include a tunnel vision of just searching for potential pharmaceuticals in human health and ignoring the use of complex plant extracts, and limited association between different role-players within science and especially between science, industry and legislation. The wide scope of possible applications, especially in agriculture, will be identified and discussed with some examples. Finally a model will be proposed that could be considered to increase the delivery of tangible products, which would increase the rational use of plant natural products to the benefit of the people in Africa.

THEME 1:

WATER AVAILABILITY AND ACCESS

Theme 1

SEMINAR PAPER 1:

STRATEGIES FOR INCREASING AGRICULTURAL WATER PRODUCTIVITY IN PHYSICALLY AND ECONOMICALLY WATER-SCARCE REGIONS OF ACP

***M.M. Malesu**, World Agroforestry Centre (ICRAF), Kenya*

Keywords: agricultural development, food production, irrigation, soil erosion

The African, Caribbean and Pacific (ACP) Group of States are a group of countries currently numbering 79, of which 48 are African, 16 are Caribbean and the remaining 15 are Pacific. The group's main objectives are sustainable development and poverty reduction within its member states, as well as greater integration into the world's economy.

The region is located between latitudes 27.3 North to 35.0 South and longitude 89.7 West to 165.0 East, thus falling within the tropical and sub-tropical zones. Other than the Caribbean and Pacific island nations, the soil pattern in Africa is quite complex while the cropping pattern is diverse because of striking differences in parent materials, landforms, altitude and climate.

By 2002, the ACP had a total population of 727 million people, representing 15% of the total population of developing countries – with 94% living in Africa, close to 5% in the Caribbean and only 1% in the Pacific countries. Per capita GDP of the ACP countries varies significantly, ranging from more than US$9,000 (€6,380) in some Caribbean countries to less than US$100 (€71) in the poorest African country. Agriculture accounts for 16% of the GDP in this region. With regard to productive sectors, ACP countries rely more on agriculture for income and employment generation.

Agriculture is mainly rain-fed and varies widely among and within ACP countries. While population growth in sub-Saharan Africa is increasing at an annual rate of 3%, food production is lagging behind at 1-2%, mainly due to land degradation, soil erosion, high yield losses caused by weeds, insects, economic and physical water scarcity, low use of inputs, climate change and related disasters. Further, the increased prevalence of HIV/AIDS among the population has decreased labour availability and consequently farm productivity. This is further aggravated by inadequate investments in human capital, agricultural infrastructure, and research and extension networks. Owing to the above, there is a serious manifestation of hunger and malnutrition across the ACP region.

In comparison with other developing countries, whose proportion of arable land irrigated by 2001 was 26%, the percentage for ACP countries was only 4.9. Likewise, fertiliser use in other developing countries was 110 kg/ha compared to 14.8 kg/ha for the ACP.

To exploit the full potential of agricultural and rural development to reduce hunger and under-nourishment in the ACP countries, additional resources must be mobilised, specifically to facilitate the management of water resources including rainwater harvesting, promote irrigation and improve food security. The overall aim of this paper is to highlight the water scarcity problems facing the ACP countries and strategies to address these challenges. The paper also highlights success stories involving best practices.

SEMINAR PAPER 2:

CURRENT AND FUTURE RESPONSES TO DRIVERS OF CHANGE FOR WATER AVAILABILITY AND USE FOR AGRICULTURE

***Prof. Elijah K. Biamah**, Department of Environmental and Bio-Systems Engineering, University of Nairobi, Kenya*

Keywords: agricultural development, food production, irrigation

Sustaining water availability for agriculture in the near future presents a great challenge and opportunity for the communities in the ACP countries. They must play a fundamental role in creating and maintaining access to and availability of this scarce resource for present and future generations. This would effectively improve agricultural productivity and overall economic growth.

The challenge has been heightened, as problems with freshwater quality and availability have multiplied and changed in response to growing population and economic activity over the past several decades. Adequate water supplies to meet basic human needs are essential to maintain and enhance the welfare of all the inhabitants of the ACP countries. For the present generation, water-related concerns primarily focus on the distribution of the resource within society and the preservation and protection of water quality. For future generations, additional concerns will be to ensure adequate water supplies and preserve the quality of the environment, in addition to achieving greater equity in the distribution of water throughout the countries.

The key drivers of change that will impact future water availability include: macro-environmental factors that create the broad context for development; and micro-environmental factors that affect particular elements of the agro-hydrologic system. All these factors interact and influence each other within the system/scenario.

Future water availability scenarios will be influenced by the following drivers:

(1) demographic – population structure, population growth, urbanisation and associated water demands, pressures of industrialisation and migration within ACP countries;

(2) technological – information technology, land use technologies, biotechnology, renewable energy technologies (i.e. hydropower generation), water-use efficiency, water pollution, new drought-, pest- and salt-resistant crops, sanitation, desalination;

(3) social – lifestyles and cultural preferences, poverty, economic inequality;

(4) environmental – committed to future climate change, water-related diseases, salinisation, exhaustion and pollution of surface and groundwater, integrity and health of aquatic ecosystems;

(5) governance – institutions, legislation, market dominance, power structure, conflicts, globalisation.

Access to water in the ACP countries will be influenced significantly by actual availability, access policies, available infrastructure and institutions. Successful interventions will be introduced under enabling conditions for agriculture at various hierarchical policy levels. A few of these enabling conditions that are elaborated upon include: appropriate land-use policy; focus on smallholder conservation agriculture; and public and private partnerships.

CASE STUDIES 1:

WATER SCARCITY ADAPTATION STRATEGIES FOR VULNERABLE RURAL COMMUNITIES

STRATEGIES FOR INCREASING WATER PRODUCTIVITY AMONG FARMERS IN TAUNG IRRIGATION SCHEME OF NORTH-WEST PROVINCE, SOUTH AFRICA

O.I. Oladele *and* ***S.S. Tekena****, Department of Agricultural Economics and Extension, North-west University, Mafikeng, South Africa*

Keywords: farmers, South Africa, strategies, Taung irrigation scheme, water productivity

The Taung irrigation scheme was established in 1939 by the South African government and covers 1,054 ha. It was established to provide water to support livelihood activities, due to the prevailing semi-arid and arid conditions of the area. The scheme has gone through several management and administration schemes over time, with a view to improving its impact on users. At present, about 71% of the irrigation scheme is under a centre-pivot system, and the remaining area is covered by a conventional sprinkler system. The scheme allocates at least 1.7 ha per farmer.

This paper examines the current strategies used to harness and maximise the effective use of the scheme. These strategies include the introduction of the scheme to emerging farmers, formation of farmers groups and cooperatives, creation of an extension area for the scheme, and allocation of an extension officer to cover the scheme. Others include diversification of crop production, creation of a marketing outlet, and micro-finance for farmers in the scheme. The paper concludes with how each of these strategies has helped to improve the productivity of water from the irrigation scheme.

SUSTAINABLE SOIL AND WATER MANAGEMENT FOR SMALLHOLDER FARMS

Ramgopaul Roop *and* ***Seunarine Persad****, Agricultural Development Consultants with the Trinidad and Tobago Agri-Business Association (TTABA), Trinidad and Tobago*

Keywords: heavy clay soils, soil fertility and water management, strategic alliances, sustainable agricultural development, sustainable soil and water management

In Trinidad and Tobago, approximately 70% of the land allocated for farming consists of heavy clay soils. Characteristically, these heavy clays suffer from impeded drainage in the wet season and desiccation and cracking in the dry season, and are dense and compact on the surface and subsoil. Soil fertility and water management are critical issues to be addressed nationally to revitalise our agricultural sector. The challenge is therefore to develop and implement measures to ensure sufficient water is available during the dry season and other periods of expected water shortage, and to provide adequate drainage systems for excess water in the rainy season.

This paper reports on a 3-year research project, conducted on a 3-acre (1.2 ha) smallholder farm which consisted of acidic clay soil with pH 3.5, to ameliorate and install a sustainable water management system to produce a wide range of fruits and vegetables throughout the year. Strategic alliances were established with the farmers and key researchers from the Ministry of Agriculture, the University of the West Indies and other agricultural agencies. The efforts are documented in research publications.

Over the past 25 years, we have developed and tested processes of managing heavy clay soils by the implementation of innovative soil and water management techniques required for sustainable agricultural development of small farms in Trinidad and Tobago.

While developing a sustainable water management plan for commercial farms (100+ acres) (41 ha), the following

were considered: Storm-water Management Plan, Sediment and Erosion Management, Wastewater Treatment System, Water Quality Management Plan and Quality Assurance Project Plan.

SUSTAINABLE AGRO-SYLVO-PASTORAL ACTIVITIES AROUND LAKE LAGDO

***Abamet Kaïgama**, Programme and Projects Officer, Technical Advisor, Cellule pour le Développement Intégré et l'Environnement (CELDIE), Cameroon*

Keywords: crops, fish, land, trees, water

Lake Lagdo is an artificial lake, created in the north of the Republic of Lagdo/Cameroon in 1984 for three purposes: hydroelectricity, agriculture and fishing. The reservoir covers a total area of 700km^2; it is 70km long, 15km wide, 10m deep and contains 7 billion m^3 of water. The study area covers about 103 villages with an estimated population of over 100,000, and produces around 500,000 t of grain per annum. Poor farming practices and deforestation are sanding up the lake, reducing its holding capacity and degrading the surrounding land. Less than 1% of the water in the lake is used for sustainable agriculture, and the figure for rainwater is even lower.

We are working with beneficiaries and development partners in order to establish good integrated water resources management, initially to conserve water in the reservoir, and then to step up agro-sylvo-pastoral and fishery production, so that they can keep pace with demographic growth. Our strategy for this integrated management is outlined below. Activities to raise awareness of environmental issues (including deforestation, use of non-conventional fishing tackle, aquatic and terrestrial pollution, using rainwater and water from the lake more productively for agricultural purposes) are done in order to reverse the degradation of soils, water and fishing resources, and use them in a sustainable manner.

We provide training on sustainable production techniques, such as using conventional fishing tackle and good fishing practices, improved ovens, improved cropping techniques and crop diversification (annual and irrigated crops). Irrigated crops are grown downstream from the dam (rice, maize, sugar cane) and the area is dotted with market gardens. We support actions related to drinking water and waste management as communities need to be healthy in order to be productive, and because access to potable water and waste management is unfortunately very limited in the intervention zone.

WATER MANAGEMENT AND THE EMERGENCE OF OFF-SEASON CROPS IN THE FORMER COTTON BASIN OF CAMEROON

***Watang Zieba Félix**, Lecturer/Researcher in rural geography, Department of Geography, Université de Maroua, Cameroon*

Keywords: Far North Region of Cameroon, former cotton basin, off-season crops, water management

Cotton was introduced in the Far North Region of Cameroon in the 1950s. Nearly half a century later, the rural economy of this region has been severely compromised by plummeting cotton prices, dwindling rainfall and declining soil fertility. More and more off-season crops are being grown to compensate for the deficits created by the slump in cotton sales. These include market garden produce like onions and other vegetables, and off-season sorghum or muskuwaari – all thirsty crops that require permanent access to water. An increasing number of farmers have turned to these crops in the last 10 years, requiring more and more land to do so. According to the Far North Regional Department for Agriculture and Rural Development, the area under off-season crops increased from 90,000 ha in 1999 to 200,000 ha in 2006.

Faced with the growing need for water and lack of water resources, producers are organising themselves so that they can manage water resources in a sustainable way. The objective of this study is to determine the means and mechanisms they use to secure permanent access to water and jointly manage water resources, so that they can develop these crops and thus help strengthen the rural economy in the former cotton basin. In order to do this, we needed to find out what producers do to gain and maintain access to sufficient water, and used secondary data from

the agricultural services on the amount of land cultivated and yields produced. Interviews with other actors in the rural area (public authorities, NGOs, researchers) provided information on the methods used to train producers to effectively manage water and develop sustainable off-season agriculture, which can play a key role in the rural economy of a region that has been profoundly affected by unstable cotton prices.

Analysis of the results obtained from the preliminary surveys is one element of our innovative strategy to enable producers to organise themselves into groups and put in place shared water points, develop growing spaces and install modern irrigation equipment, and to provide training on efficient new irrigation techniques in an area where water resources are in short supply. Success in producing off-season crops could breathe new life into this former cotton basin.

MANAGING SCARCE WATER RESOURCES AND CLIMATE CHANGE FOR SUSTAINABLE AGRICULTURAL PRODUCTION IN THE CARIBBEAN

***Leslie Anthony Simpson**, Natural Resources Management Specialist, Caribbean Agricultural Research and Development Institute (CARDI), Trinidad and Tobago*

Keywords: agriculture, Caribbean, climate change, drought, management

Many of the soils in the Caribbean, combined with the prevailing climate of the region, predispose the predominantly rain-fed agricultural production systems to periods of severe water shortage. With global climate change, these periods of drought are likely to become longer and more frequent. This presentation discusses some of the agricultural practices in the region, which are effective in managing this decreasing water resource. It also proposes some of the water management systems and agricultural practices that must be strengthened to ensure that the region is equipped to cope with a drier future.

FOCUSING ON THE UNDERSERVED?

***Fenny Adeline Zandgrond**, Senior Journalist, Ware Tijd, Suriname*

Keywords: agricultural policy, gold mining, irrigation, Suriname

Poster presentation

In its agricultural policy, Suriname is divided into four regions: East, West, Central and South. East, West and Central form the coastal strip, and the South region is the interior that covers about 80% of the country. In the interior of Suriname, predominantly Maroons and indigenous people live in tribal communities. They depend heavily on agriculture, which they practice on the land surrounding their villages. Rivers, creeks and swamps deliver irrigation water. These waterways are subject to weather conditions and changes in other sectors, such as the gold sector. The distance between their wells and plots often determines the quality and quantity of the harvest.

There is competition for processed water between villages close to gold fields and small-scale miners. For farmers in these communities, it is hard to find good irrigation water, as they also have to share this with the gold processes which are highly water-consuming. Many creeks and rivers surrounding gold fields are polluted, have dried up or faded away. The government has never invested in water management, e.g. construction of irrigation canals in the interior (South region). This presentation looks at specific allocations for agriculture development in the interior, and constraints and recommendations, among other aspects.

SIMULATING THE SENSITIVITY OF MAIZE CROP PROPAGATION TO SEASONAL WEATHER CHANGE USING CROPWAT-8

***T.A. Ewemoje** and **S.A. Okanlawon**, Agricultural and Environmental Engineering Department, University of Ibadan, Nigeria*

Keywords: Cropwat-8 model, irrigation scheduling, seasonal change, temperature variation, yield reduction

The paper simulates the sensitivity of maize crop yield response to temperature increase with appropriate irrigation scheduling, which may obviate the negative impact of temperature increase on crop yield. The model was run with weather records from the International Institute of Tropical Agriculture (IITA), Ibadan, for the period 2000–2008, with the yearly weather records divided into quarterly records depicting maize crop growth seasons from planting to harvesting. Quarterly growth seasons were January–May (I), May–September (II), and September–January (III) – the respective seasons for maize crops.

Simulation results were analysed using the SPSS statistical tool and the method of Least Square Deviation. The results revealed that an increase in the average temperature by 1°C, 2°C and 3°C for the growth seasons results in average yield reduction. Average yield reduction ranges were 5.3–8.7% (season I), 0% (season II) and 0.5–1.7% (season III) when irrigation was done at the user-defined interval of 3 days; 6.1–8.4% (season I), 0% (season II) and 1.7–0.8% (season III) when irrigating at critical depletion of 2mm water application depth and at rain-fed condition; 17–21% (season I), 0% (season II) and 3.6–7.2% (season III) respectively. This shows that in season II, temperature rise has no effect on maize yield due to the availability of rainfall at optimum growth conditions. However, temperature negatively impacted on the maize crop yield in seasons I and III with little or no rainfall. Hence, user-defined intervals of 3 days and 2mm water application depth performed best in the three seasons.

MOBILISING SURFACE WATER RESOURCES FOR AGRICULTURAL PURPOSES IN THE DEPARTMENTS OF MONO-COUFFO

Ibouraima Yabi, Fulgence Afouda *and* ***Michel Boko,***
Université d'Abomey-Calavi, Benin

Keywords: agricultural production, Mono-Couffo (Benin), suggestions, unreliable rainfall, water mobilisation

Mono-Couffo is renowned as a highly productive agricultural region and home to some of the granaries of southern Benin. However, in recent years agricultural output has declined due to unreliable rainfall in this region.

This study uses data on the decadal and monthly levels of rainfall, taken from the ASECNA-Cotonou base, along with information provided by key actors (producers, agricultural extension agents, etc.) and direct field observations. Trend analysis, frequency and the Force-Pressure-State-Response (FPSR) model were used to process the data.

Our findings show an increase in rainfall anomalies in the study area, characterised by the late onset and early ending of the rainy season, which dries out its clayey soils and has a marked effect on agricultural yields. Efforts to deal with the consequences of unreliable rainfall in the study region have mainly focused on using surface water for agricultural purposes. Such initiatives are worth pursuing and maintaining in order to achieve sustainable agricultural production.

COMMUNITY EVOLVED MODEL FOR RESTORATION AND MANAGEMENT OF A DYING WATER SOURCE

David K. Nkwanga*, Nature Palace Foundation, Uganda*

Keywords: adaptation, community-evolved model, restoration

River Bukoola is found in the semi-arid area of Rakai District in the south-western part of Uganda. It is approximately 70km long and connects two water bodies: Lake Kijanebalora and Lake Victoria. For decades, the River Bukoola has played a significant role for the local people all along its course, as a source of water for people, their animals and agriculture. It still stands as a key feature in aiding the local population to adapt better to the effects of climate change. However, over the last 5 years the water levels of the river have drastically dwindled, due to the effects of climate change coupled with the indiscriminate destruction of its banks through tree cutting, uncontrolled grazing and river bank gardening. This is exposing the population and their animals to extreme vulnerability and threatened livelihoods.

Facilitated by the Nature Palace Foundation, the community has developed an integrated water conservation and management model that involves riverbank restoration, water governance through water management committees and a wider watershed management plan. The community-

evolved ecosystem rehabilitation model divides the river ecosystem on either side of the river into three zones and stipulates interventions in each of the zones. These aim to restore the river ecosystem and its water catchments while addressing other key community needs, such as access to water and food, while promoting resilience to climate change.

INTEGRATED WATER RESOURCES MANAGEMENT AND SUSTAINABLE AGRICULTURE IN NIGERIA: A STUDY OF THE SOKOTO-RIMA BASIN

***W.B.R. Graham**, Principal Lecturer, Department of Agricultural Engineering, Waziri Umaru Federal Polytechnic, Nigeria*

Keywords: floodplains, irrigation, soil conservation, upland systems, water management

The Sokoto-Rima system in north-west Nigeria is part of the wider Niger Basin. In 1969, the Food and Agricultural Organization carried out a soil and water resources study of the basin and recommended a number of modest dams, barrages, irrigation schemes and polders as part of a comprehensive basin development plan.

This study has been used as the basis for the construction of grandiose and capital-intensive irrigation projects in the region by successive Nigerian governments. The impact of upstream activities on the reservoirs and downstream impact of the impoundments on traditional floodplain agriculture were not taken into consideration in the planning of these projects. These impacts are currently further aggravated by reduced and extremely variable rainfall. In most cases, these projects are in a continuous cycle of degradation and rehabilitation. For example, the Wurno Irrigation Project is about to undergo the fourth rehabilitation in its 50-year history. With the commencement of construction of the 50,000 ha Zauro Polder Project, it seems lessons have not been learnt. This paper stresses that drought and desertification, soil degradation, deforestation and overgrazing, reservoir sedimentation and flooding, poverty etc. are all interrelated factors affecting sustainable agriculture in the basin. It is therefore essential to use a holistic approach in the management of the water resources in the area. This can be done through integrated water management.

CLAY POT IRRIGATION AND PLANTING DENSITY EFFECT ON LETTUCE YIELD

***Abdul-Halim Abubakari, G. Nyarko** and **Sheila Maalinyuur**, Faculty of Agriculture, University for Development Studies, Ghana*

Keywords: clay pot, irrigation, vegetables, wastewater, watering can

An experiment (Completely Randomised Design) was set up to determine the response of lettuce growth and yield to clay pot irrigation and planting density. The treatments were: clay pot irrigation with 15cm × 15cm planting density (treatment 1); clay pot irrigation with planting density of 20cm × 20cm (treatment 2); and clay pot irrigation with planting density of 30cm × 30cm (treatment 3). Control treatments were set up as watering can irrigation with planting density of 15cm × 15cm (treatment 4); watering can irrigation with planting density of 20cm × 20cm (treatment 5); and watering can irrigation with planting density of 30cm × 30cm (treatment 6).

Treatments were replicated three times, giving a total of 18 experimental units. Eighteen large enamel basins (50cm in diameter and 20cm high) were then filled with good topsoil. Clay pots (made with 1:2 ratio of sand to clay) were buried neck-deep in eight of the basins. Three-week-old lettuce seedlings were planted in all the 18 basins, 5cm away from the walls of the basin according to the treatments. Each day, 500ml of wastewater was applied to both clay pot and watering can treatments. The parameters studied were plant height, number of leaves, leaf area index, head circle, and the dry and fresh weight of leaves and roots. The data was analysed using Genstat. The results indicate that clay pot irrigation supported the highest density of planting, and promoted better growth and lettuce yield.

CASE STUDIES 2:

WATER STORAGE FOR CLIMATE CHANGE ADAPTATION (RECOVERING RAINWATER)

INTEGRATED RAINWATER HARVESTING AND MANAGEMENT SYSTEMS FOR SUSTAINABLE DEVELOPMENT IN SEMI-ARID ENVIRONMENTS OF KENYA

***Dr Stephen Ngigi**, Projects Coordinator, **Katie Allan**, Information and Communication Officer and **Susan Kung'u**, Greater Horn of Africa Rainwater Partnership (GHARP)/ Kenya Rainwater Association (KRA), Kenya*

Keywords: climate change, micro-irrigation, rainwater harvesting and management, semi-arid environment, smallholder farmers

Smallholder rain-fed agriculture in the semi-arid environments (SAE) of Kenya is being affected by increasing water scarcity. SAE receive low, erratic and poorly distributed rainfall (200–800mm per year) and suffer from persistent drought, which is being made more vulnerable by climate change. The bimodal rainfall pattern also aggravates water scarcity due to less rain per crop-growing season, and intra-seasonal dry spells which affect crop yields. Smallholder farmers rely on seasonal rainfall for their subsistence agriculture, but with the increasing impacts of climate change, this livelihood system is becoming unsustainable.

However, integrated rainwater harvesting and management (RHM) systems and complementary technologies can help smallholder farmers increase and diversify crop production, and hence shift from subsistence to commercial agriculture. RHM leads to improved utilisation of available rainwater to reduce water stress, especially through supplementary irrigation during the intra-seasonal dry spells, and use of water-efficient drip irrigation for vegetable production. This paper demonstrates some of the RHM technologies for smallholder farmers in semi-arid districts of Kenya. In particular, the paper focuses on on-farm rainwater storage structures (50–100m^3 farm ponds) for vegetable production under low-head drip irrigation systems.

The innovation is integrated RHM systems (farm ponds) and complementary technology (drip irrigation) as a climate change adaptation strategy for smallholder farmers in vulnerable SAE. The paper draws on the 15 years of experience of the Kenya Rainwater Association and shows how their knowledge and understanding of RHM technologies has evolved into an integrated technological package for unlocking the potential of smallholder farmers in SAE.

MEETING RICE PRODUCTION AND CONSUMPTION DEMANDS OF WEST AFRICA WITH IMPROVED WATER MANAGEMENT TECHNOLOGIES

***Kwame Osafredu Asubonteng, M.M. Buri, R.N Issaca, E. Annan-Afful** and **T. Wakatsuki**, Council for Scientific and Industrial Research (CSIR) Soil Research Institute, Ghana*

Keywords: benchmark, inland valley, paddy, *sawah*, slash-and-burn

The average rice yield obtained by smallholder rice farmers in West Africa is very low (0.5–1.5 ha^{-1}). This is due to the fact that most smallholder rice farmers in the sub-region still cultivate rice in their traditional slash-and-burn rain-fed method, without any improved soil and water management technology. Over 60% of rice requirements in the sub-region is therefore imported. Inland valley swamps, which have specific hydrological conditions suitable for rice cultivation by smallholder farmers, occur abundantly in the West African sub-region. However, there are major water management constraints which hinder rice production. To overcome these constraints, an improved soil and water management system (bunded, levelled and puddle fields with irrigated water from simple dykes for irrigated rice cultivation, also known as *SAWAH* SYSTEM) was studied alongside the traditional rain-fed lowland rice cultivation method

of local farmers at a benchmark site in Ghana. Results obtained indicate that the paddy rice yield obtained was significantly higher (an average yield of 5.0t/ha^{-1}) with the *sawah* method than the farmers' method. The research also indicates that one success of the *sawah* technology is that improved water management on the rice fields positively changed the soil chemistry by decreasing soil acidity, increasing both essential macro- and micro-nutrients suitable for rice growth.

ECONOMIC AND ENVIRONMENTAL RELATED ASPECTS OF WATER STORAGE IN SUB-SAHARAN AFRICA

Stefanos Xenarios *and* ***Matthew McCartney****, International Water Management Institute (IWMI), East Africa & Nile Basin Office, Ethiopia*

Keywords: benefits, costs, decision-aiding, storage schemes

The introduction of cost and benefit-like analyses for the identification of optimal solutions in water storage comprises a common principle in decision-making processes. However, the analyses of costs and benefits often do not consist of an appropriate decision guideline in developing countries. Particularly, the difficulty of capturing the relevant data and interpreting the information in financial terms is a burdensome task with ambiguous results.

To this aim, this paper suggests the introduction of a set of qualitative and quantitative attributes related to economic efficiency and environmental impact criteria, to aid decisions in water storage selection processes. The research is focused on sub-Saharan Africa and mainly on small storage schemes used for irrigation purposes. The methodology is tested in six representative clusters situated in Ethiopia and Ghana. The results indicate a distinct improvement in the decision-aiding process which is underpinned by transparent procedures.

SIMULATING THE IMPACT OF CLIMATE CHANGE ON YIELD REDUCTION OF VEGETABLE CROP PROPAGATION USING CROPWAT-8

T. A. Ewemoje *and* ***P.O. Ashaolu****, University of Ibadan, Nigeria*

Keywords: climate change, CROPWAT-8 Model, vegetable crop, yield prediction, yield reduction

The effects of climate change on the yield reduction and prediction of vegetable crops was studied using CROPWAT-8 with irrigation scheduling conditions; critical depletion at a water application depth of 2mm, and definite interval of 3 days at a depth of 2mm and no irrigation. The model was run using the 9-year weather records for Ibadan, Nigeria, spanning 2000 to 2008. The yearly weather records were divided into quarterly records depicting vegetable crop growth periods from planting to harvesting.

Quarterly growth seasons were January– April (I), April–July (II), July–October (III) and October– January (IV) for the vegetable crop with an increase temperature rise of 1^{o}C. Simulation results analyses for 2000 to 2008 under critical depletion reveal that at each 1^{o}C temperature rise from ambient condition to 3^{o}C, yield reduction for season I ranges from 9– 12.3%, 0–0.2% for season II, 0% for season III and increasing from 12.2% to 14.9% for season IV. Also, from the prediction analysis (for 2009–2013) obtained from the SPSS statistical tool and the method of Least Square Deviation for ambient weather condition of the study location, there are higher yield reductions of 9–11.68% for season I, 0–0.77% for season II, 0–0.76% for season III, and 12.2–12.0% for season IV. Hence, climate change has impacted negatively on the higher predicted yield reductions for three of the four seasons considered from 2009 to 2013.

IDENTIFYING SUITABLE AREAS FOR WATER HARVESTING IN THE UPPER BLUE NILE BASIN, ETHIOPIA

Yihun Dile, Louise Karlberg *and* ***Johan Rockström,*** *Stockholm Environment Institute, Ethiopia*

Keywords: Multi-Criteria Evaluation, Suitability analysis, Upper Blue Nile, water harvesting

Extreme variability in rainfall, characterised by high intensity storms, and the high frequency of dry spells and droughts is one of the major contributing factors to famine and environmental degradation in Ethiopia over the last 40 years. Climate change projections have indicated that these climatic shocks will become more frequent in the coming decades. Studies have shown that water harvesting systems can turn these challenges into opportunities. In this paper, the potential and locations of suitable areas for water harvesting of the Upper Blue Nile Basin in Ethiopia are identified using a GIS-based Multi-Criteria Evaluation (MCE) technique. Moreover, the sensitivity of the water-harvesting suitability to different constraint factors, i.e. precipitation, slope, land cover and soil, is assessed.

The analysis indicates that a large part of the Upper Blue Nile Basin is suitable for water harvesting: 6–24% of the land area was classified as highly suitable for water harvesting, and areas considered moderately suitable cover more than 50% of the land area. The range of values within each suitability class is the result of the varying influence assigned to the constraint factors, and this study showed that precipitation is the most influential factor for water-harvesting suitability in this basin.

DECENTRALISED RAINWATER HARVESTING STRUCTURES IN INDIA: RELEVANCE FOR ACP COUNTRIES

Ravinder P.S. Malik, Meredith Giordano *and* ***Vivek Sharma,*** *International Water Management Institute (IWMI), India*

Keywords: decentralised, community, cultivable, rainwater harvesting, structures

Excessive use of groundwater by farmers for irrigation over the years has led to a dramatic fall in groundwater tables of up to 400–500 feet (122–152m) in the Dewas district in the Indian state of Madhya Pradesh. New investments in tube wells failed to yield any groundwater. Faced with an acute shortage of irrigation water and a steep drop in incomes, the farmers resorted to harvesting rainwater – but with a difference. Aware of problems associated with cost sharing and the potential conflicts involved in water sharing from communal structures, some enterprising farmers decided to build rainwater harvesting structures on individual farmer's land. Accordingly, these innovative farmers built individual rainwater harvesting structures, devoting, as a rule of thumb, one-tenth of their cultivable land for storing rainwater. The depth of the structures varies from 7 to 25 feet (2–8m), but in general the structures can hold water for about 5 months. Since their introduction 4 years ago, more than 4,000 structures have been built.

The farmers have reportedly recovered their investment in about 3 years and have experienced significant livelihood benefits. For example, while farmers continue to grow soybeans in the *Kharif* (wet season), in the *Rabi* (dry season), when land was previously kept fallow, farmers can now cultivate wheat and gram with the water made available from the water harvesting structures. Further, the fodder made available as a by-product of wheat has encouraged farmers to invest in livestock, and some farmers have also introduced aquaculture activities in the storage ponds. This model of rainwater harvesting offers substantial scope for scaling up in other regions and countries that are similarly placed to the study region.

RAINWATER HARVESTING PRACTICES AND DESIGN OF A RAINWATER HARVESTING SYSTEM FOR OTUKPA COMMUNITY, BENUE STATE, NIGERIA

S.B. Onoja, I.E. Ocheja *and* ***M.O. Isikwue****, Department of Agricultural and Environmental Engineering, University of Agriculture, Makurdi, Nigeria*

Keywords: harvesting, Otukpa, rainwater, rooftop, system

The Otukpa community in Ogbadibo Local Government Area, Benue State, Nigeria, has difficulty in accessing both surface and groundwater. The people depend on rainwater harvesting for drinking, and other domestic uses and agro-processing activities also need water. This dependence is total during the rainy season, and partial during the dry season, as long distances are traversed to supplement the harvested rainwater. This study investigated the rainwater harvesting practices in Otukpa community. These investigations included determining the roofing patterns, the potential yield of rainfall that could be harvested, and rainwater quality. The study found that people practice rooftop rainwater harvesting techniques. The roofs were made of galvanised corrugated iron sheets. The potential annual yield for rainwater harvesting ranged from 157,200 l to 571,600 l, depending on the size of the rooftops. The actual harvests were much lower than these, constrained by the capacities of available reservoirs. The capacities of the reservoirs ranged from 15,780 l to 95,420 l per household, and 104,010 l for the primary school.

The quality of rainwater harvested in the area showed that if properly managed, it was generally good water for domestic use. An elevated rainwater harvesting system comprising of harvesting surface and reservoir was designed for 450,000 l to cater for 250 people at the WHO-recommended rate of 30 l per capita per day (for rural areas) to last the critical months of March, April and May – the period of water scarcity in the area. The cost of one of such system was 2,870,050 Naira (€13,525). This system can be constructed in different parts of the community and can be used in similar communities with similar water problems. Governments, NGOs and international organisations are hereby called upon to assist the community by building the rainwater harvesting system designed in this work as a sustainable means of water supply to Otukpa.

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THEME 2:

PUBLIC POLICY AND INVESTMENT

Theme 2

SEMINAR PAPER 5:

INCREASING WATER ACCESSIBILITY: STRATEGIC INVESTMENT AND POLICY PRIORITIES IN AGRICULTURAL WATER MANAGEMENT

***Dr W. Teshome**, Addis Ababa University, Ethiopia*

Keywords: agriculture, investments, water governance, water management

About two-thirds of the total population of ACP countries depend directly or indirectly upon agriculture for livelihood. Countries in the ACP region will face challenges in the years to come as they try to embark upon economic growth, especially those focused on hunger and poverty. This paper reviewed information on strategic investments and policy priorities in agricultural water management as the key to ensuring the increase in water accessibility in many ACP countries, where water demand outstrips available resources. Various options of investments in agricultural water management are identified, including irrigation, groundwater and rainwater harvesting. Investment resources, policies and institutional arrangements are explored. The key drivers that will impact future water availability for agriculture, such as climate change and water governance, are assessed. The paper sets out the changing context of demand and supply for agricultural water and identifies the policy, institutional and incentive reform options that help meet the challenges in increasing water accessibility. It articulates priorities for investment in agricultural water management and the pay-offs and trade-offs that must be made.

PANEL PRESENTATION 1:

INVESTING IN SMALL-SCALE IRRIGATION AND RAIN-FED SYSTEMS

INITIAL ACHIEVEMENTS OF THE WEST AFRICA IRRIGATION PROJECT (WAIPRO) TO REVITALISE IRRIGATION SCHEMES IN THE SAHEL

***Herve Lévite, Hilmy Sally**, International Water Management Institute (IWMI) and **Clément Ouedraogo**, Comité permanent inter états de lutte contre la sechersse dans le Sahelé (CILSS), Burkina Faso*

Keywords: Burkina Faso, food security, irrigation, Niger, participatory assessment

The rehabilitation of public irrigation schemes in West Africa is a regularly recurring issue, especially in light of the region's food crises. Many are still quite new, but little is done to maintain them and they are often no longer very productive or even viable. At first, these expensive infrastructures were entirely managed by the State; then, in the 1990s, many were rehabilitated and their management transferred to local people. However, this did not result in the expected improvements. Instead, tension over water resources has risen as sedimentation has reduced the amount of water the reservoirs can hold and competition between users has increased. This has led to local conflicts and a growing reluctance among donors to support efforts to rehabilitate irrigation schemes.

Nevertheless, repeated episodes of drought and demographic pressure in the region have rekindled interest in policies to provide water for agriculture by establishing new irrigation schemes and rehabilitating existing systems. USAID West Africa decided to support this type of project following the massive rise in grain prices in 2008. IWMI proposed an action-research programme focusing on Niger and Burkina Faso, implemented in collaboration with CILSS, which is interested in promoting water for agriculture in the Sahel.

The main hypothesis of the WAIPRO project is that poor water management in hydro-agricultural developments adversely affects producers' output and incomes. IWMI aims to improve understanding of recent developments in the sector through participatory technical and socio-economic assessments. Producers should be actively involved in these exercises so that they engage with management reforms. A broad rehabilitation action plan for works and capacity building has been systematically drawn up, in the hope that it will galvanise producers into focusing on management practices. In order to motivate them and measure their progress, farmers are asked to look at their performance and create a simple management chart to monitor it. In parallel with this, we are getting national research institutions to work on measures of profitability (socio-economic study), monitor varieties and redefine fertiliser supplies. The five assessments so far undertaken in the context of the WAIPRO project have already confirmed well-known facts and revealed new information.

PANEL PRESENTATION 2:

INVESTMENTS FOR IMPROVING ACCESSIBILITY IN ECONOMICALLY WATER-SCARCE REGIONS

MAXIMISING AGRICULTURAL WATER PRODUCTIVITY REQUIRES THE RIGHT POLICIES AND INPUTS, PARTICULARLY IN WATER SCARCE REGIONS

***Dennis Wichelns**, International Water Management Institute (IWMI), Sri Lanka*

Keywords: economic incentives, farm-level credit, insurance, markets, yields

Scarcity can sharpen the perspectives of resource users, and the public officials who are responsible for allocating resources wisely among competing interests. In a sense, scarcity complicates the challenge we address in this paper – that of increasing agricultural water productivity – yet it also provides one part of the solution. Scarcity motivates farmers to choose irrigation strategies carefully and to apply water efficiently, provided that scarcity conditions are communicated accurately in water prices, allocations, or rights. Hence, public efforts to increase agricultural water productivity must begin with ensuring that farmers and other water users appreciate in tangible terms the current scarcity conditions and the outlook for water supplies and demands in future. In brief, water policies and strategies must reflect the water scarcity conditions.

Strategies must also include efforts to ensure that farmers have affordable access to complementary inputs, timely transport, and viable markets. Essential inputs include high-quality seeds, nutrients, chemicals, financial credit, and technical assistance that is consistent with agricultural production in water scarce regions. Maximising water productivity requires that farmers do not miss opportunities to produce high yields because other inputs are limiting. Farmers must also have access to effective storage and transport, so that crop yields are not reduced between the farm and market. In brief, water specialists must recognise and promote the importance of non-water inputs in efforts to increase agricultural water productivity, particularly in water-scarce regions. The strategies described in this paper reflect and build upon this enhanced perspective regarding scarcity and agricultural water productivity.

SEMINAR PAPER 6:

REVITALISING ASIA'S IRRIGATION: ARE THERE ANY MEANINGFUL LESSONS FOR AFRICA?

David Molden, Aditi Mukherji *and* ***Regassa Namara,***
International Water Management Institute (IWMI), Sri Lanka

Keywords: Africa, Asia, irrigation, policy environment

Irrigation has always played a central role in the agrarian economy of Asia, from supporting famed hydraulic civilisations in the ancient past to spearheading the Green Revolution in the 1960s and 1970s. Asia accounts for 70% of the world's irrigated area and is home to some of the oldest and largest irrigation schemes. While these irrigation schemes played an important role in ensuring food security for billions of people in the past, their current state of affairs leaves much to be desired. This paper analyses the current trends in irrigation in Asia and suggests ways and means for revitalising irrigation for meeting our future food needs and fuelling agricultural growth. The paper recommends a five-pronged approach for revitalising Asia's irrigation and provides region-specific strategies for the same. The underlying principal of these multiple strategies is the belief that the public institutions at the heart of irrigation management in Asia need to give up comfortable rigidity and engage with individual users' needs and the demands placed by larger societal changes.

If revitalising existing irrigation schemes in Asia is a challenge, building and sustaining them in Africa is an even more daunting one. The sub-Saharan African countries in particular need to grow more food and the answer lies in agricultural water management, including irrigation at an appropriate scale. This paper analyses the trends in agricultural growth and finds that while crop cultivation is highly prone to rainfall shocks, the livestock sector is less so. A review of institutions and policies, especially within the Nile countries, shows that organisations like the Nile Basin Initiative (NBI) embedded within a paradigm of 'water sharing' places a lower emphasis on agricultural water management because such water use is consumptive in nature. So, while the need for investment in agricultural water management is acute, the policy environment for doing so is constrained. It is in this context that cross-learning from experiences in Asia may help to inform policy process and investment opportunities in Africa.

GREEN WATER CREDIT SCHEME AS A MANAGEMENT MECHANISM FOR SUSTAINABLE AGRICULTURE: EX-ANTE ASSESSMENT IN MALAWI

O.C. Ajayi, F.K. Akinnifesi, G. Sileshi, T. Beedy, A.O. Ajayi, S. Mng'omba *and* ***B.I. Nyoka****, World Agroforestry Centre (ICRAF), Malawi*

Keywords: climate change, contingent valuation, payment for environmental services, rain-fed agriculture, river basins development

Land degradation and deforestation impact negatively on green water supply for sustainable agriculture and food security of Malawi. This problem is compounded by climate change, which increases the risks of unpredictability in water supplies in rain-fed farming. One response to these problems is the 'Green Water Credit' (GWC) scheme, a mechanism to reward good land management practices that improve the quantity and quality of water for agriculture. But information on the cost of degradation of the Shire Basin is not available, thus limiting the ability to make informed policy decisions on the prospects for GWC in the basin.

We evaluated the prospects for implementing GWC in the basin by estimating: (a) economic cost of degradation in the Shire basin on major utility companies; (b) willingness of public consumers to co-finance GWC. The results showed that the degradation of the river basin affects agriculture and stakeholders in different ways. For the electricity generation utility company, costs included increased incidence of aquatic weeds reaching 2,500 t per month, higher operational costs estimated at US$960,000 (€680,000) per annum, and lost revenue of US$1.2 million (€850,000) annually due to power outage. For water utility boards, the cost of water treatment increased between eight to ten times. Over half (54%) of the electricity consumers interviewed are willing to pay extra costs to co-finance GWC up to US$8.8 (€6.2), equivalent to 42% of monthly electricity bills. It is concluded that GWC as a scheme to ensure water for sustainable agriculture is feasible, subject to hydrological assessments, effective governance arrangements, and appropriate incentive mechanisms.

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THEME 3:

WATER AND SOCIETY

CASE STUDIES 3:

WATER GOVERNANCE AND WATER SECTOR REFORM

POVERTY REDUCTION LINKAGE WITH WATER MANAGEMENT IN SUB-SAHARAN AFRICA

***Elemide Oyebola Adebola**, Senior Lecturer, Federal College of Agriculture, Nigeria*

Keywords: linkage, poverty reduction, sub-Sahara Africa, water management

The global community is united in its commitment to remove the scourge of world poverty through actions that bring different interests and organisations together in effective partnerships around the Millennium Development Goals agenda.

This paper analyses the links and outlines the different ways in which improvements to water management can advance the cause of poverty reduction. The contribution of water management to poverty reduction goes far beyond just drinking water and sanitation. Water is essential for improving the health and livelihoods of the poor, ensuring wider environmental sustainability, reducing urban squalor and eradicating hunger. It is also critical in addressing gender inequalities and improving access to education for the poor.

This paper illustrates that improving the contribution of water management to poverty reduction is not just achievable, it is affordable. In many cases, it is a good investment that generates growth and gives a rate of return comparable with investments in any sector. The benefits are directly targeted to the poor and especially to women, who bear many of the burdens that a lack of investment in water creates. Investing in water, in reforms to the institutions that govern water management, and creating more effective partnerships to focus international support on water and environmental sustainability, are all essential.

All aspects of poverty are considered, which is reflected in the analysis of water's potential contribution to all of the Millennium Development Goals. The political prominence of water issues is all too often not translated into investment priorities in sub-Sahara African countries.

AGRICULTURAL WATER USE IN TWO DIVERSE RIVER BASINS – A QUICK COMPARISON OF THE LIMPOPO AND THE INDO-GANGETIC BASINS

***X.L. Cai, B.R. Sharma** and **P. Karimi**, International Water Management Institute (IWMI), South Africa*

Keywords: agricultural water use, basin, Indo-Gangetic, Limpopo

The Limpopo Basin and Indo-Gangetic Basin (IGB) are two diverse basins with enormous pressures on water for food production. Based on outputs from the CGIAR Challenge Program on Water and Food (CPWF) Basin Focal Projects in these two basins, this paper aims to explore the reasons for the differences in agricultural water uses and the implications for each other. The paper firstly summarises the methods used to assess agricultural water use and productivity in these two basins. Then the crop water uses and water productivity indicators are compared. The differences were linked to various spatial factors including cropping patterns, precipitation, climate conditions and topography, which provide indications for high potential interventions.

The results showed very different crop water consumption patterns in the two basins. Although in both cases much of basin-available water is consumed through evapotranspiration, the IGB uses more of this water for crops while the Limpopo uses much less. There is no significant difference in the rate of crop water consumption, but the Limpopo Basin gains much less crop production, though a lot of water is still consumed. The factor analysis revealed that the IGB tends to use more water than needed, and the water consumption in the fields of Limpopo does not often have the right timing. The implications are that while water saving is a major task in the IGB, providing crops with the right amount of water at the right time is the key for the Limpopo Basin.

SUSTAINABLE PROFESSIONAL AGRICULTURE IN A RIVER VALLEY SETTING

***Abamet Kaïgama**, Technical Advisor, Cellule pour le Développement Intégré et l'Environnement (CELDIE), Cameroon*

Keywords: annual agricultural calendar, development, irrigation, rain, river water

Most river valleys provide an ideal setting for a range of agricultural, fishing, pastoral and even forestry activities. Some 17,000 ha of the Bénoué valley are reserved for agriculture, but so far only 2,000 ha of this land have been used for this purpose; the remaining 15,000 ha have yet to be developed for agricultural use. Water is essential for the livelihoods of farmers, herders and foresters alike.

The objective is for farmers to keep producing all year round by growing two types of crop: rain-fed crops during the wet season and irrigated crops during the dry season. The first task is to develop the land, and then build farmers' capacity to manage two growing cycles a year in order to increase yields and incomes, reduce poverty and raise local living standards.

Various villages and farmers in the valley now produce both dry- and rainy-season crops, harvesting two crops of rice, maize and market garden produce each year. The State encourages this double production in order to help improve food security.

Given the general social organisation in the valley, this new type of agriculture could increase yields, provided the conditions for development are in place and materials for irrigation (pivot irrigation) made available. Environmental protection also needs to be taken into account, in accordance with the environmental norms of the host country.

BETTER INTEGRATED WATER RESOURCES MANAGEMENT AS A MEANS OF SUPPORTING AGRICULTURE: THE NEED FOR ECONOMIC AND FINANCIAL INSTRUMENTS

***K. Sena Adessou, D. Kofi Sodahlon** and **André Tokpa**, African Institute for Economic and Social Development - African Training Centre (INADES-Formation), Togo*

Keywords: economic and financial instruments, IWRM, sustainable agriculture

It is recognised that water is a key resource for life and development. According to the Millennium Development Goals, this century is characterised by huge challenges that are preventing billions of people from getting better access to sustainable water services. No one doubts the need to manage the water sector more effectively and efficiently, nor the positive consequences that this will have, especially in enabling countries to boost their development through agriculture. Agriculture is by far the largest consumer of water in every region of the world except for Europe and North America, accounting for some 69% of global consumption and up to 84% of Africa's water resources (FAO).

In this context, economic and financial instruments represent management and investment tools that can help ensure fair and sustainable access to water to develop sustainable agriculture – and also protect ecosystems. These instruments can provide incentives to increase or decrease water consumption, raise equity capital, recover costs, reduce pollution and support reforms in the sector.

In an environment where water management is the cornerstone of sustainable agriculture, and each cubic metre of water used for rain-fed agriculture needs to be made more productive, it is essential to investigate, analyse and refine these instruments so that they can be applied effectively. They clearly have an important role to play.

DO CONVENTIONAL MODELS OF IRRIGATION REFORMS WORK? A GLOBAL REVIEW OF IRRIGATION MANAGEMENT TRANSFER (IMT) AND PARTICIPATORY IRRIGATION MANAGEMENT (PIM)

Aditi Mukherji, Nari Senanayake *and* ***Blanka Fuleki,***
International Water Management Institute (IWMI), Sri Lanka

Keywords: irrigation management transfer, participatory irrigation management

Irrigation management transfer and participatory irrigation management (IMT/PIM) have been buzzwords in the irrigation sector for about 30 years. However, in spite of years of implementation and hundreds of documented case studies, evidence of the impacts of IMT/PIM has at best remained sketchy. The purpose of this paper is to fill in some of the gaps left in the previous reviews, through a meta-analysis of 182 documented case studies of IMT/PIM from 43 countries in Africa, Asia and Latin America. For the purpose of the review, all the case studies were coded on a number of context-specific parameters. This was followed by construction of a composite success score comprising nine outcome and impact variables, and each case study was assigned a unique score and ranked in terms of success or failure. The majority of cases (64% in Asia, 70% in Africa and 52% in Latin America) were deemed to be failures as per this system of classification – a system that proved robust when compared against the judgment of the case study authors.

Based on systematic review of these case studies, it was found that successful cooperative action in large-scale public irrigation systems takes place under a set of very context-specific and process-intensive conditions – conditions that are difficult and costly, if not impossible, to replicate elsewhere. It is also argued that the lack of replicability of successful cases of IMT is not an issue of poor implementation or enabling conditions, as is generally thought, but is related to the conceptual weakness of the IMT model itself. There is therefore a need for a paradigm shift in the way publicly owned irrigation systems are managed. The paper goes on to outline the components of such a paradigm shift.

WATER USER ASSOCIATIONS IN NORTHERN GHANA: FROM INSTITUTIONAL PANACEA TO REALITY CHECK

Ernest Nti Acheampong *and* ***Jean-Philippe Venot,***
International Water Management Institute (IWMI), Ghana

Keywords: development projects, Ghana, irrigation, livelihood strategies, technology transfer

Small Reservoirs (SRs) have become an integral component of communities in Northern Ghana, supporting multiple livelihood strategies (livestock, fishing, irrigation and domestic use). In the mid-1990s and early 2000s, several donor-led development projects invested in rehabilitating and 'upgrading' SRs with irrigation infrastructures. Most projects established Water Users Associations (WUAs) meant to ensure sustainable management of the SRs. The underlying hypothesis was that local communities tend to have greater incentives than external actors to maintain their natural resources base. Organising local farmers in WUAs would increase their sense of ownership, leading to better management and performance of the system.

Evidence from Northern Ghana shows that WUAs have had mixed results. There is evidence of some WUAs having positive impacts. The paper highlights some conditions under which WUAs can trigger robust collective action for the management of a collective resource such as SRs. However, it is also clear that most WUAs failed due to weak socio-technical capacity. This paper argues that the relative failure of WUAs is mostly due to the implementation approach that was adopted for their establishment during past development projects, specifically the lack of attention given to the complex social fabric and the multiple actors and livelihood strategies that organised around SRs. Past development projects reiterated the model of 'technology transfer' but, this time, by promoting an 'institutional fix'. Government and donors should not only invest in infrastructure rehabilitation but also in soft components (organisation, capacity, extension) that need to be embedded in the local social fabric.

CASE STUDIES 4:

EQUITABLE DISTRIBUTION OF WATER RIGHTS AND ACCESS: WATER, POVERTY AND GENDER

UNDERSTANDING THE GENDERED DIMENSIONS OF ACCESS TO WATER AMONG SMALL-SCALE HORTICULTURAL FARMERS IN DOMBOSHAVA

***Ignatius Gutsa**, PhD student, Sociology Department, University of Zimbabwe*

Keywords: climate change, gender, ethnography, water

This paper examines the changing gender dynamics surrounding access to and control over water at Mutsvati dam among small-scale horticultural farmers in Mutsvati village in Domboshava district. Mustvati dam is increasingly drying up earlier as a result of a number of factors, ranging from changes in rainfall patterns in the district, increased drawing of water for irrigation and siltation over the years, and climate variability and change. In Domboshava district, small-scale horticultural agriculture is the backbone of the community; over the years it has helped to guarantee an income for those practising it and in the process has helped in overcoming poverty and enhancing food security.

This paper adopted a citizen ethnographer approach, interpreting ethnography as a research process based on fieldwork using a variety of (mainly qualitative) research techniques. These included the use of multiple research methods in the form of life histories, in-depth interviews, observation, focus group discussions and engagement in the lives of the community in Domboshava district in order to get a qualitative understanding of the nature of changing gender dynamics surrounding access to and control of water for irrigation purposes. Giddens' structuration theory is adopted as the theoretical framework to analyse the findings, which reveal that gender relations surrounding access to water are taking a new turn as the challenge in accessing water is manifesting itself among the small-scale horticultural farmers drawing water from Mutsvati dam.

THE DIFFICULT WATER SHARING IN THE UPPER COMOÉ BASIN, BURKINA FASO

***Hervé Lévite**, Consultant, International Water Management Institute (IWMI), Burkina Faso*

Keywords: dams, irrigation, Karfiguela, water sharing

Karfiguela is one of seven major rice-growing irrigation schemes in Burkina Faso. Most of the 700 irrigators of this 350 ha scheme were displaced by the establishment of a state-owned sugarcane plantation in 1968. Three dams were built to provide water for the cane and other users. But in the 2000s, the sugarcane scheme was sold to a private company which was also put in charge of the management of the public dams.

The pressure on the water resource is now growing. The Karfiguela producers want to get more water and do a double cropping, but they have difficulties making their voices heard. The private company is reluctant to release more water to them because it considers that this water is misused by the Karfiguela farmers. In this situation, it appears more and more evident that the State should take back control of the sharing of the water resource. While economic water productivity is higher for the sugar industry than for rice, the debate remains open when it comes to social impact.

Indeed, frustrations are taking a toll on the Karfiguela producers, who feel doubly aggrieved: their ancient lands have been confiscated and they no longer control their water allocation. By measuring performance of the scheme, the WAIPRO project has sought, as a first step, to provide producers with arguments that will help them during negotiations that take place annually at local water committee level and, in the future, at basin agency level.

CONFLICT AND COOPERATION OF WATER USERS IN THE NDURUMA SUB-CATCHMENT: THE ROLE OF COMMERCIAL ESTATES IN LOCAL WATER MANAGEMENT AGREEMENTS

Hans C. Komakech, Madison Condon *and* ***Pieter Van Der Zaag****, United Nations Educational, Scientific and Cultural Organization – Institute for Water Education (UNESCO-IHE), The Netherlands*

Keywords: conflict, irrigated agriculture, priority allocation, subsistence, Tanzania, water rights

In this paper, we present the struggles for water rights and access in Nduruma River, Upper Pangani River Basin, Tanzania. The spatial geography of Nduruma is such that smallholder farmers are located upstream and downstream, while large commercial estates are in the midstream part of the sub-catchment. There is not enough water in the river to satisfy all demands. The majority of the smallholder farmers' currently access water under customary arrangements, but commercial estates have state-issued water use permits. Nevertheless, to access water the estates adopt varied strategies: (1) they try to claim water access by sticking to state water law; (2) they engage and negotiate rotational allocation with the downstream smallholder farmers; and/or (3) they band with downstream farmers to secure more water from upstream farmers.

This research finds estates that were successful in securing their water access to be those who engaged with the local system and negotiated fair rotational water-sharing arrangements. By adopting this strategy, the estates not only avoid conflict with the poor downstream farmers but also gain a social reputation, increasing the chances of cooperative behaviours from the farmers towards their hydraulic infrastructure investments. We further find that dualities exist in the implementation of the state water-use permits – not only between the local and state forms of water governance but also between the differing administrative levels of government. The local governments are keen to 'keep the peace' rather than enforce the water law – which is in fact too mutable to be systematically enforceable. This paper therefore highlights how state-sanctioned water reforms acquire different meanings and perspectives at the local level.

ACCESS TO WATER FOR RICE PRODUCTION IN THE FLOODPLAINS OF CENTRAL BENIN

Pascaline Babadankpodji*, Researcher, University of Abomey-Calavi, Benin*

Keywords: climatic variability and change, gender, lowland rice production, poverty, water for agriculture

Rain-fed agricultural production systems on the cultivable lowlands of Central Benin vary according to the producer's gender: men hold direct rights to farmland while women have indirect rights of use. In recent years, climatic changes have undermined local knowledge of the physical environment and people's ability to manage agricultural production cycles. This study examines the social adaptations triggered by climatic variability and change in the zone, and the economic consequences for both sexes. It shows that in the past, when climatic conditions were better, men grew crops on dry ground while women cultivated rice and market garden crops on the heavy lowland soils, which are difficult to sow. But as the dry ground became less fertile, crops less profitable and the rains increasingly late and irregular, the men took over the land these women long relied on for their survival, despite their vital role in providing food for the household. This has contributed to the impoverishment of their wives, and led to widespread food insecurity and greater poverty and vulnerability among women and children.

THE BATTLE OF HEGEMONY: STRATEGIES TO SECURE EXCLUSIVE WATER RIGHTS – LESSONS FROM MALAWI AND MOZAMBIQUE

Francis Nkoka*, Agriculture Manager, MFA Project, Save The Children, Malawi*

Keywords: irrigation, Malawi, Mozambique, water rights

Farmer-managed irrigation systems contribute significantly to the food security of many countries in sub-Saharan Africa. Irrigation is considered as a sustainable option for food production due to the shortfall in rain-fed grain production, erratic rains and rising urban and rural populations. Failures

in large-scale irrigation systems shift the focus to small-scale systems, which have a good record of accomplishment.

The water rights of small farmers are often not clearly defined. Farmers claim their rights based on their contribution to the construction of an irrigation scheme, their location in an irrigation scheme, and their social and political networks. Often these rights systems conflict with claims by other users, as well as national legal systems. Other water users (large or commercial farmers, industries etc.) often apply for formal water rights, while smallholder farmers are neither aware nor interested due to their limited capacity to carry out the rigorous exercise of obtaining water rights. Rights are given to new users without contextualising the local situation. Examples from Mozambique and Malawi indicate that formal water rights become critical during water-scarce periods. A thorough understanding of water rights in the local realm versus national and institution understanding is very critical to sustain smallholder irrigation farming. Due to the growing pressure to use the limited water resources, smallholder farmers risk being pushed out of irrigated agriculture.

THE EMERGENCE OF WATER USER ASSOCIATIONS IN RWANDAN MARSHLANDS

***Thierry Lasalle**, Project Officer, Research and Technological Exchange Group (GRET), Rwanda*

Keywords: rice, Rwanda, Water Users Associations

In Eastern and Southern Africa, Water Users Associations (WUAs) have been recently promoted in various countries. Rwanda recently discussed the possibility to launch WUAs to better manage water in the marshland areas rehabilitated into rice fields. To consider water management as a specific task to be managed by a specific type of organisation has recently been supported by the Government of Rwanda, who drafted a specific legal framework. However, the emergence of viable and sustainable WUAs may be misunderstood by some stakeholders, especially the ones who have been performing (even imperfectly) these tasks of water management until today: namely the rice producers' cooperatives and the local authorities. Moreover, in an environment where irrigation water availability in the marshlands is highly dependent on how the surrounding hillsides are being protected, it could be more and more important to develop double-faced WUAs having competences beyond the limits of the marshlands.

On one side, WUAs may tend to be seen as irrigation management organisations acting exclusively in the marshlands, collecting a water fee from the users in exchange for guaranteeing water services in accordance with the cropping calendar necessities. The WUAs, in that case, would cover functions currently performed by the rice producers' cooperative. On the other hand, WUAs could be defined with a broader scope and manage water not only in the marshland but also in the surrounding hills. In some areas, hillside-located WUAs are about to be launched to manage water irrigation in radical terracing plots. In our view, the way WUAs will address the following questions could condition their legitimacy to sustainably manage water.

What is the scope of the responsibilities handed over to WUAs by the local authorities who are the custodians of the natural resources as common goods, and what are the means by which they are authorised to fulfil this mandate? In other words, why pay a new tax?

How to build a genuine ownership of the association by the users, with respect to their stronger rice producers cooperative which used to manage the water services and directly cut the amount of the fee from the producers sales? In other words, why not remain with the cooperative only?

How to work with hillside farmers whose practices and eventual use of water may affect the irrigated marshlands, especially when the uplands farmers have no access or limited access to marshlands? In other words, why would they care?

The presentation discusses how the government of Rwanda and the farmers' organisations have enhanced a process to launch District Water Management Coordination Committees to provide case-to-case answers to these challenges.

ASSESSMENT OF WOMEN'S PARTICIPATION IN IRRIGATED AGRICULTURE: A CASE STUDY OF OYO STATE, NIGERIA

O.A. Alade, E.A. Amao *and* ***P.O. Eniola****, Department of Agricultural Technology, The Polytechnic, Ibadan, Nigeria*

Keywords: food security, gender, livelihood, vegetables, water

Women play a crucial role in agricultural production in developing countries, accounting for an average 32% of GDP, and producing most of the food that is consumed locally, for instance vegetable, fruits and cereal crops. The majority of food production that is attributed to women makes them the leading agent of food security and household welfare in rural areas. In most irrigated agriculture, women are involved in activities like planting, weeding, harvesting, fertiliser application and marketing, with little or no access to land, inputs, water and other agricultural services as compared to men. This study aims to determine the personal characteristics of respondents, type of crops grown, activities carried out during irrigation practices, effects on their livelihood and constraints faced in irrigated agriculture.

The study showed that the majority of the women are married with an average of five children. Women mostly grow vegetables and are involved in activities like planting, weeding, transportation and marketing of produce. They face problems such as lack of access to land, credit and water facilities. Irrigated agriculture has been able to improve the livelihoods of women with increased income and production, which is helping them to meet family needs like paying their children's school fees and settling medical bills. Women should be provided with credit facilities and reliable water sources through cooperative societies and agricultural banks for them to be involved in the cultivation of other crops, which will enhance women's agricultural productivity, reduce poverty and boost food security.

WATER SUPPLIES AND USES BY RURAL HOUSEHOLDS IN THE LIMPOPO PROVINCE OF SOUTH AFRICA

K.A. Tshikolomo, A.E. Nesamvuni, B.M. Petja *and* ***S. Walker****, Limpopo Department of Agriculture, South Africa*

Keywords: household, municipality, water management area, water supply, water use

Access to adequate water supplies is a universal indicator of human development. Respondents from 467 households from 10 villages in three municipalities in the Luvuvhu-Letaba Water Management Area were interviewed using a structured questionnaire. The purpose of the study was to investigate the socio-economic conditions of households and their water supplies and uses.

The majority (54.9%) of heads of household were male, in the middle ages of 36–50 (34.8%) and 51–65 (26.6%) and were less educated. Households were small, with a maximum of four members each, and had low incomes where 41.1% earned R0–R1000 (€0–103) and 40.4% earned R1001–R5000 (€104–519) monthly. Ownership of houses suggested that households were well off due to some houses being freely provided by government.

50.1% of households obtained water from street pipes and 46.7% travelled less than 1km to a water source. The quantity fetched was variable; 7.4% fetched 0–25 l and 21.2% fetched more than 200 l per day. More households only used water for basic activities such as drinking (95.9%), cooking for home consumption (95.4%) and bathing (92.8%) compared to those who used it for productive activities of washing cars (6.6%) and watering crops (5.7%). The quantity used for a basic activity was mostly only 0–25 l per household. Accordingly, four in five households were dissatisfied with the water supply in the area. The Department of Water Affairs, together with relevant stakeholders, should explore opportunities for increasing supplies which will allow more water to be used for both the basic and productive activities necessary to improve household economy.

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THEME 4:

KNOWLEDGE SUPPORT SYSTEMS

Theme 4

ACTION RESEARCH FOR SOCIAL LEARNING AND WATER RESOURCES GOVERNANCE – A FACILITATIVE SERVICE APPROACH

***Dr Bruce Lankford**, Senior Lecturer and Head of School, University of East Anglia, UK*

Keywords: irrigation, water resources governance

The presentation will draw on research, over the last 10 years, of irrigation policy and delivery in sub-Saharan Africa that focuses on farmers and the service providers (e.g. district engineers) that support them. It will be argued that irrigation support programmes should shift away from being dominated by consulting engineers towards a mix of services offered by NGO and government personnel, engineers and social scientists.

Key distinguishing markers of this approach are: long-term engagement around an action-research programme (effecting, monitoring and reflecting on science-and-service delivery); the role of scientists as brokers of knowledge; multi/trans-disciplinarity; the promotion of local experts, leaders and artisans as catalysts of community learning and infrastructural redesign; frameworks of mono/polycentric governance; and, a facilitative process of change management including a gaming approach to natural resource management. Examples from sub-Saharan Africa are employed to illustrate the principles made.

STRATEGIC ANALYSIS AND KNOWLEDGE SUPPORT SYSTEM (SAKSS): INFORMING THE IMPLEMENTATION OF THE COMPREHENSIVE AFRICA AGRICULTURE DEVELOPMENT PROGRAM (CAADP) IN AFRICA

***Pius Chilonda**, Head, International Water Management Institute (IWMI), South Africa, **Michael Johnson** and **Samuel Benin**, Research Fellows, International Food Policy Research Institute (IFPRI), Washington, D.C., USA*

Keywords: African Union, CAADP, ReSAKSS

Recognising that Africa's agricultural sector offers the greatest opportunity for leveraging growth and alleviating poverty and food security on the continent, African Union (AU) member countries are now currently implementing the Comprehensive Africa Agriculture Development Program (CAADP). To support this initiative, the Regional Strategic Analysis and Knowledge Support System (ReSAKSS) and a network of national, regional and international partners are helping to provide access to policy-relevant analysis, data and tools in order to promote evidence-based dialogue and facilitate the bench marking and review process associated with the CAADP agenda. For example, under the knowledge management and communication component, ReSAKSS and its network of partners are collecting data on key indicators such as public spending and agricultural sector growth to facilitate timely access by African policymakers and development partners. To this end, ReSAKSS has developed an interactive website (www.resakss.org) with geographically referenced, simply formatted, and easily accessible data and indicators that monitor and evaluate progress of CAADP implementation by all partners and stakeholders. The website features visualisation tools and analysis of key agricultural development trends at the country and regional level.

KNOWLEDGE-SHARING APPROACHES FOR PROMOTION OF INTEGRATED WATER MANAGEMENT IN SEMI-ARID AREAS OF NORTH-EASTERN TANZANIA

***K.F.G. Masuki, M.M. Malesu, Z.A. Mattee, F.B. Rwehumbiza** and **S.D. Tumbo**, African Highlands Initiative (AHI)/World Agroforestry Centre (ICRAF), Kampala, Uganda*

Keywords: communication and knowledge sharing, integrated water management, smallholder systems innovations, water system innovations

One of the main challenges for researchers in natural resources management is to turn knowledge into action

to achieve tangible results and outcomes to improve livelihoods of the smallholder farmers. This poster presents the case that enhanced knowledge sharing ensures that research findings are well communicated to key stakeholders in order to achieve improved livelihoods and influence decision-making and utilisation of improved technologies.

This case is used to demonstrate the outcomes of communicating research findings on integrated water management and turn them into action by smallholder farmers in semi-arid areas of north-eastern Tanzania. A communication strategy was developed and implemented to enhance information and knowledge sharing. Different methods were used to share information and knowledge to provide an opportunity for feedback to researchers and farming community. These methods include farmers' workshops, exchange visits, farmer field schools, demonstrations, farmer field days, audio visual and river basin game. The implementation of the communication strategy involved active participation of the District Council, a nexus of development at local level, to ensure continuity after the end of the project. It was learnt that adoption of integrated water management innovations depends on the combination of different information sharing tools and methods. Interactive folklore methods complemented with audio-visual and printed media become more effective and foster experiential learning.

THE SUITABILITY OF DOMESTIC ROOF-HARVESTED RAINWATER AS A SOURCE OF IRRIGATION WATER FOR HOMESTEAD GARDENING

O.A. Akintola *and* ***A.Y. Sangodoyin****, Farming Systems Research, National Institute of Horticultural Research (NIHORT), Ibadan, Nigeria*

Keywords: anthropogenic factor, homestead gardening, irrigation, pollution, rainwater

Homestead gardening is often recommended to make fresh and good quality crops available for householders in developing countries of the world. To achieve this, a source of irrigation is imperative. Contamination of surface and shallow wells due to improper handling of industrial and domestic wastes is the main reason why the use of domestic roof-harvested rainwater (DRHRW) is generally being recommended. Rainwater is expected to be clean, since it has been purified in the hydrological cycle. Attention is usually on the quantity rather than the quality of harvested rainwater. Hence this study investigated the quality of DRHRW harvested under varying environmental conditions in relation to its use for irrigation of homestead garden.

DRHRW was collected in Ibadan, Lagos and Port Harcourt, Nigeria, representing predominantly residential, industrial and gas-flaring regions respectively. In each location, DRHRW from four roof materials (corrugated iron sheet, long span aluminium, asbestos and step tiles) and three ages of roof (<5 years, 5–10 years and >10 years in service conditions) were investigated.

The major microbiological contaminant found was Escherichia coli at 1.00–2.50, 0.98–6.00 and 0.49–3.11 × 105cfu/mL respectively for Ibadan, Lagos and Port Harcourt. Pseudomonas flourescens was detected in 23.0%, 53.0% and 69.0% of samples in Ibadan, Lagos and Port-Harcourt respectively. For the three locations, lead and cadmium were detected in the ranges 0.01–0.13mg/L and 0.01– 0.15mg/L respectively. These were traced to anthropogenic factors. Iron and nitrate were within the range 0.21–1.13mg/L and 51.05–305.93mg/L respectively.

The properties of DRHRW in Nigeria are microbiologically not safe for all locations and chemically not safe for irrigation purposes in industrial and gas-flaring areas, where cultivated crops will accumulate heavy metals and other contaminants from irrigation water and thereby pass it to man through the food chain.

EVALUATION OF THE IMPACT OF FARMER PARTICIPATION IN HYDRO-AGRICULTURAL DEVELOPMENTS: THE CASE OF TRAINING PROGRAMMES FOR AGRICULTURAL WATER USERS' ASSOCIATIONS IN SMALL AND MEDIUM IRRIGATION PROJECTS IN THE NORTHERN PROVINCES OF MOROCCO

***Berrhazi Ridouane**, Head of Irrigation Service, Ministry of Agriculture/Department of hydro-agricultural development, Chaouia Ouardigha Regional Department of Agriculture, Morocco*

Keywords: Agricultural Water Users' Associations, collective action, development, small participatory approach, rehabilitation, medium irrigation projects

In 1996, small and medium irrigation projects to develop irrigation schemes in the northern provinces of Morocco incorporated several rehabilitation projects into the participatory project cycle. The main component of the development projects, which followed a new approach known as Participatory Irrigation Management (PIM), was to establish Agricultural Water Users' Associations (AWUAs) that would be capable of managing and using existing infrastructure and amenities and playing a concrete role in the different phases of the development project, from identifying and contributing to studies and monitoring works, to support through training sessions and monitoring and evaluation.

The aim of this paper is to assess water users' participation in these projects by examining how AWUAs function and participate in the different phases of activities; to identify the factors hindering this participatory dynamic; and to provide useful lessons for subsequent projects of this kind.

One of the strengths of this participatory approach is that it facilitates various forms of appropriation by establishing new working partnerships between users, businesses and the administration, training new leaders and making state interventions in these sensitive areas more credible.

FROM RADIO AND RESEARCH GARDENS TO MULTIMEDIA FOOD FESTIVALS

***Mike Kambalame**, Senior Video Producer, Story Workshop, Malawi*

Keywords: film, multimedia, *Mwana Alirenji*, video

This video highlights the process which the *Mwana Alirenji* project went through to come up with a village food festival. *Mwana Alirenji* is a project that has been funded by the European Union since 1999. It started as a radio programme but included radio research gardens and low literacy illustrations in its 2003 phase. After seeing that the low literacy illustrations needed someone to explain, the project matured to a Multimedia Community Project in 2007 that runs up to 2011.

One of the multimedia aspects in the project is the instructional film. The film is produced based on perceived problems and their possible solutions. When all is set, the 45–60 minute instructional film is taken to the village where community mobilisers work with the community for 5 days using different tools in different groups within the village, in what are popularly known as village food festivals. On the evening of the fourth day, the instructional film is shown on a big screen in the village.

Mwana Alirenji, a full multimedia project, continues to inspire and has benefited many people through the networking forum that it offers at village level. Soil conservation, irrigation, water harvesting using simple and appropriate technologies, and the use of manure are the popular issues that are mostly featured in the instructional films.

Mwana alirenji, a common Malawian expression meaning 'there is nothing a child can cry for when there is plenty of food' aims to attain self-food reliance among small-scale farmers in rural Malawi.

RAISING AWARENESS IN ORDER TO PROTECT THE RIVER MILO, NIGER: THE ENDANGERED MILO

***Sangare Aminatagbe**, Journalist, Radio Télévision Guinéenne, Republic of Guinea*

Keywords: drinking water, pollution, River Milo, River Niger

Great wealth brings great responsibility. Every citizen has a role to play in protecting our fresh waters. After all, our lives depend upon it, just as we depend on the air we breathe and the land we cultivate. The first step in ensuring that every citizen has access to clean drinking water is to protect it at its source. Yet one of Guinea's most important water sources – the River Milo – is under threat.

The River Milo is one of the tributaries of the majestic River Niger, the legendary West African artery whose source lies in Guinea. The River Milo defines Kankan as the Seine defines Paris or the Thames London. The 430km River Milo emerges in the Beyla plateau and runs down through the prefectures of Kérouané and Kankan in Upper Guinea. Its river basin covers some 13,100km^2, feeding several cultivable plains in the region. But like the Niger, which is the largest river in West Africa and the third largest on the continent after the Nile and the Congo, the Milo is threatened by drought and desertification. The Niger is 4,200km long, with a basin covering some 2,274,000km^2. It has many attributes, providing potable water, edible fish and a beautiful natural environment in the nine countries through which it flows.

One of its tributaries, the Milo, runs through Kankan, a big commercial centre that is particularly important for agricultural produce. Located 680km from the Guinean capital Conakry, Kankan has a sub-Saharan climate influenced by the Harmattan, with a 7-month dry season lasting from October to April and a 5-month rainy season from May to September. Its average annual rainfall is 188.3mm. Kankan's population of 355,739 farmers, fishermen, artisans, sand extractors, traders and their households (2005 official statistics) is fed by the Milo and its resources. But there is a real danger that this river will disappear if nothing is done.

Forty years ago the river was navigable from July to January. Today, it is only navigable for a brief period between the end of October and the end of January. Less water means that there are fewer resources to cultivate the fields and water livestock. And less water combined with high demographic growth means that these activities now have to compete with each other on less land, making it harder to reduce poverty.

Both the Niger and the Milo are adversely affected by desertification, as sand is constantly deposited into their beds while chunks of their furrowed banks break off into the water, weakened in part by inappropriate methods of sand extraction.

The source in Faranah is eroding and crumbling under the weight of demographic growth, over-grazing, agriculture and deforestation. Once a source of nourishment, the river is turning into a dustbin, polluted by untreated domestic and industrial waste, dyes, agricultural inputs and solid waste.

In short, we now need to argue for a strategy, possibly at the regional level, to ensure that the river and its related resources are used and developed in a sustainable manner. For the people who live along its banks it is absolutely essential to increase awareness of how the river functions and the issues and challenges associated with it, among both communities and decision-makers.

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ACRONYMS AND ABBREVIATIONS

ACP	African, Caribbean and Pacific
AfDB	African Development Bank
AHI	African Highlands Initiative
ASENCA	Agency for Aerial Navigation Safety in Africa and Madagascar
AU	African Union
AWUA	Agricultural Water Users Association
CAADP	Comprehensive Africa Agriculture Development Program
CARDI	Caribbean Agricultural Research and Development Institute
CELDIE	Cellule pour le développement intégré et l'énvironnement
CEO	chief executive officer
CGIAR	Consultative Group on International Agricultural Research
CILSS	Comité permanent inter-états de lutte contre la sécheresse dans le Sahel
CPWF	Challenge Program on Water and Food of the CGIAR
CSIR	The Council for Scientific and Industrial Research
CTA	Technical Centre for Agricultural and Rural Cooperation (ACP-EU)
DRHRW	Domestic roof-harvested rainwater
DWAFF	Department of Water Affairs, Forestry and Fisheries
EU	European Union
FAO	Food and Agricultural Organization of the United Nations
FPSR	force-pressure-state-response
GDP	gross domestic product
GHARP	Greater Horn of Africa Rainwater Partnership
GIS	geographic information system
GRET	Research and Technological Exchange Group
GWC	Green Water Credit
GWP	Global Water Partnership
ICRAF	World Agroforestry Centre
ICM	information and communication management
ICT	information and communication technology
IFAD	International Fund for Agricultural Development
IFPRI	International Food Policy Research Institute
IGB	Indo-Gangetic Basin
IITA	International Institute of Tropical Agriculture
IMT/PIM	irrigation management transfer/ participatory irrigation management
IWMI	International Water Management Institute
IWRM	integrated water resource management
KRA	Kenya Rainwater Association
KSS	knowledge support system
MCE	multi-criteria evaluation
NBI	Nile Basin Initiative
NEPAD	The New Partnership for Africa's Development
NIHORT	National Institute of Horticultural Research
NGO	non-governmental organisation
NPCA	NEPAD Planning and Coordinating Agency
ReSAKSS	Regional Strategic Analysis and Knowledge Support System
RHM	rainwater harvesting and management
SAE	semi-arid environments
SACAU	Southern African Confederation of Agricultural Unions
SPSS	Statistical Package for the Social Sciences
SR	small reservoir
TTABA	Trinidad and Tobago Agri-Business Association
UNESCO-IHE	United Nations Educational, Scientific and Cultural Organization – Institute for Water Education
USAID	United States Agency for International Development
WAIPRO	West Africa Irrigation Project
WHO	World Health Organization
WRC	Water Research Commission
WUA	Water Users Association
WUR	Wageningen University

SEMINAR PROGRAMME

Time	Session Details		Session Facilitation
DAY 1: MONDAY 22 NOVEMBER 2010			
08.30–10.00	Participant registration		Seminar Secretariat
10.00–10.30	COFFEE BREAK		
10.30–12.00	Participant registration (cont'd)		Seminar Secretariat
	Briefing session for CTA Annual Seminar Team		
	Briefing session for session chairs and facilitators of plenary session, members of the Steering Committee, leaders of the working groups, moderators and note takers of the working groups		CTA Team and Seminar Steering Committee
12.00–14.00	LUNCH BREAK		
16.00–18.00	SESSION 1: Official Opening Ceremony A joint opening session for all four events of the CTA week		Session Chair
	16.00–16.50	Official Opening Ceremony	
		Master of Ceremonies	
		Welcome remarks: Dr Ibrahim Mayaki, CEO, NEPAD/NPCA, South Africa	
		Opening remarks: Mr Michael Hailu, Director, CTA, The Netherlands	
		Greetings from the Caribbean	
		Greetings from the Pacific	
	16.50–17.10	Keynote Address I: Doubling yields in the face of water scarcity and climate change	
		Dr David Molden, Deputy Director-General, International Water Management Institute (IWMI), Sri Lanka	
	17.10–17.30	Keynote Address II: Science, indigenous knowledge and innovation – challenges for development	
		Prof. J.N. Eloff, Research Professor and Leader, Phytomedicine Programme, University of Pretoria, South Africa	
	17.30–17.50	Feature Address and Launch of CTA/NPCA Week: Hon. Minister of Science and Technology, South Africa	
	17.50–18.00	Vote of Thanks: Mr Fred Kalibwani, IWMI, South Africa	
	18.00–18.30	Press conference	
18.30–20.00	Cocktails		
20.00	End of Day 1		

Time	Session Details	Session Facilitation
DAY 2: TUESDAY 23 NOVEMBER 2010		
08.00–10.30	SESSION 2: Plenary presentation of four seminar papers Each seminar paper presentation will be 20 minutes followed by 10 minutes of questions and comments moderated by the Session Chair	Session Chair
	08.00–08.15 Overview of objectives and the structure of the seminar Mr André Vugayabagabo, CTA, The Netherlands; Mr Fred Kalibwani, IWMI, South Africa	
	08.15–08.35 Seminar Paper 1: Strategies for increasing agricultural water productivity in physically and economically water-scarce regions. The paper will discuss: • Strategies for reallocating water and its benefits across users as well as strategies for more efficient water use – more crop per drop and more value per drop • The most promising combinations of small-scale water storage technologies for specific agro-ecological zones and ways of out-scaling them Mr Maimbo Malesu, World Agroforestry Centre (ICRAF), Nairobi, Kenya	
	08.35–08.55 Seminar Paper 2: Current and future responses to drivers of change for water availability and use for agriculture. The paper will discuss: • Key drivers that will impact future water availability and use for agriculture in the ACP countries • Examples of current responses in various countries and any other adaptive strategies to climate variability and change that will also help in reducing pressure on water systems Prof. Elijah Biamah, University of Nairobi, Kenya	
	08.55–09.15 Seminar Paper 3: Water governance, water sector reform and social justice. The paper will discuss: • Improving water governance through integrated water resources management • How water can best be governed in the contexts of specific basins in the ACP regions • Models and options for water-policy reform and governance based on sound scientific and economic evidence • Equitable water management policies, and more even distribution of water resources (water rights) Dr Faustin Maganga, Institute of Resource Assessment, University of Dar-es-Salaam, Tanzania	

Time	Session Details				Session Facilitation
	09.15–09.35	Seminar Paper 4: The interrelationship between the current levels of investment, current productivity and growth rates, and current levels of poverty and hunger in the ACP (Growth Linkages) A trends analysis for 'business as usual' and 'business not as usual' scenarios To be identified			
10.00–10.30	COFFEE BREAK				
10.30–12.30	SESSION 3: Working groups and case study presentations Participants will be divided into four working groups. The participants will remain in the same working groups all through the seminar Each working group will have 4–5 case study presentations and 4–5 poster presentations (spread over the 3 seminar days) Each working group will discuss the issues raised in the related seminar paper presentation as well as issues emerging from the case studies and poster presentations				Session Chair
	10.30–11.00	Plenary presentation of the results of the e-discussion and introduction of working group sessions, Mr George de Gooijer, Independent Consultant, Sweden			
	11.00–12.30	*Working Group 1* Water scarcity adaptation strategies for vulnerable rural communities Case studies and discussions Dr Stefan Thiemann Consultant, Switzerland	*Working Group 2* Water storage for climate change adaptation (recovering rainwater) Case studies and discussions Mr Maimbo Malesu ICRAF, Kenya Dr Stephen Ngigi RWH	*Working Group 3* Water governance and water sector reform Case studies and discussions Mrs Avril Alexander GWP – Caribbean, Trinidad and Tobago Dr Leslie Simpson CARDI, Jamaica	*Working Group 4* Equitable distribution of water rights and access (water, poverty and gender) Case studies and discussions Dr Gert Jan Veldwisch WUR, The Netherlands
12.30–14.00	LUNCH BREAK				
14.00–15.30	SESSION 3 (cont'd): Working group discussions and case study presentations continued				Session Chair
	14.00–15.30	*Working Group 1* Water scarcity adaptation strategies for vulnerable rural communities (cont'd)	*Working Group 2* Water storage for climate change adaptation (recovering rainwater) (cont'd)	*Working Group 3* Water governance and water sector reform (cont'd)	*Working Group 4* Equitable distribution of water rights and access (water, poverty and gender) (cont'd)
15.00–15.30	COFFEE BREAK				

Time	Session Details		Session Facilitation
15.30–17.30	SESSION 4: Panel session on public policy and investment		Session Facilitator
	Increased public investment in a wide range of agricultural water management options in order to increase availability and access to water for agricultural production, as well as a conducive policy environment to support increased investment and growth		Hard Talk Journalist Expert Panel NEPAD/NPCA
	15.30–16.00	Seminar Paper 5: Increasing water accessibility: Strategic investment and policy priorities in agricultural water management. The paper will respond to five key questions: • In the context of competing demands for the limited resources available, in what areas of agricultural water management should ACP countries invest? What are the pay-offs and what trade-offs must be made? • What is the operational feasibility of these investments in the current political context? What resources are required and what role can the private sector play? • Is the current policy context in the region sufficient to support increased investment in the agricultural water sub-sector? What policy changes need to accompany the proposed investments? • What complementary investments are required in order to realise the benefits of increased investment in the agricultural water management? • What is the cost of taking no action? Dr Woldeab Teshome, Director of Regional and Local Development Studies, Addis Ababa University, Ethiopia	Ms Nobu Ngele, Department Water Affairs, Forestry and Fisheries (DWAFF), South Africa Ishmael Sunga (SACAU), African Development Bank (AfDB) Dr David Molden, Deputy Director General, IWMI Dr Andrew Sanewe, Water Research Commission (WRC) of South Africa
	16.00–16.45	Panel response and presentation (and facilitated Q&A) Prioritising investment in small-scale irrigation and rain-fed systems Mr Clément Ouédraogo, CILSS, Burkina Faso Public policy and investments for improving accessibility in economically water-scarce regions Dr Dennis Wichelns, IWMI, Sri Lanka A conducive policy environment for effective investment in water Dr Rudolph Cleveringa, IFAD, Italy	
	16.45–17.30	Facilitated Q&A and panel wrap up	
17.30	End of Day 2		

Time	Session Details					Session Facilitation
DAY 3: WEDNESDAY 24 NOVEMBER 2010						
08.00–10.00	08.00–08.30	Seminar Paper 6: Revitalising Asia's irrigation: Are there any meaningful lessons for Africa? Dr Aditi Mukherij, Researcher, IWMI, Sri Lanka				
	SESSION 5: Working group discussions and case studies (cont'd) In this session, the working groups will also discuss any issues relating to public policy and investment					Session Facilitator
	08.30–10.00	*Working Group 1* Water scarcity adaptation strategies for vulnerable rural communities and Public policy and investments	*Working Group 2* Water storage for climate change adaptation (recovering rainwater) and Public policy and investments	*Working Group 3* Water governance and water sector reform and Public policy and investments	*Working Group 4* Equitable distribution of water rights and access (water, poverty and gender) and Public policy and investments	
10.00–10.30	COFFEE BREAK					
10.30–12.00	SESSION 6: Case studies on Knowledge Support Systems Information and knowledge support systems in IWM as evidence-based decision-support-tools to inform policy and investment decisions, as well as increasing uptake of adaptation and management practices Action research for social learning and water governance – a facilitative service approach, Dr Bruce Lankford, University of East Anglia, UK Strategic Analysis and Knowledge Support System (SAKSS), Dr Pius Chilonda, Head, IWMI, South Africa CTA's experience in ICM and Knowledge Support Systems, Mrs Oumy Nidaye, Head of Communication Services Department, CTA, The Netherlands ICM and KSS in IWM as evidence-based decision-support tools to inform policy and investment decisions, Dr Gervais Mbarga, University of Moncton, Canada					Session Chair
12.00–14.00	LUNCH BREAK					
14.00–15.30	SESSION 7: Interactive session for working groups (Market Place) Open space opportunity for mid-seminar feedback from groups as well as an opportunity for groups to cross-fertilise each other with new ideas					Session Chair
	14.00–15.30	Market space interaction and feedback from the four working groups				
15.30–16.00	COFFEE BREAK					

Time	Session Details	Session Facilitation
16.00–17.30	SESSION 8: Working group discussions (cont'd) In this session, the working groups will discuss information and communication management (ICM) strategies for addressing emerging knowledge gaps within the group	Session Chair

16.00–17.30	*Working Group 1* Water scarcity adaptation strategies for vulnerable rural communities and ICM strategies	*Working Group 2* Water storage for climate change adaptation (recovering rainwater) and ICM strategies	*Working Group 3* Water governance and water sector reform and ICM strategies	*Working Group 4* Equitable distribution of water rights and access (water, poverty and gender) and ICM strategies

19.00 – 20.30	Prize-giving ceremonies for CTA • Ardyis Essay Contest • CTA Peoples' Choice Photo Contest on People, Water and ICTs
20.30–22.00	Gala Dinner
22.00	End of Day 3

DAY 4: THURSDAY 25 NOVEMBER 2010

08.30–17.30	SESSION 9: Field visit The field visit will be both thematic and recreational
17.30	End of Day 4

DAY 5: FRIDAY 26 NOVEMBER 2010

08.30–10.00	SESSION 8 cont'd: Working groups continue discussing information and communication management (ICM) strategies for addressing emerging information and knowledge gaps within the group

	Working Group 1 Water scarcity adaptation strategies for vulnerable rural communities and ICM strategies plus Final presentations	*Working Group 2* Water storage for climate change adaptation (recovering rainwater) and ICM strategies plus Final presentations	*Working Group 3* Water governance and water sector reform and ICM strategies plus Final presentations	*Working Group 4* Equitable distribution of water rights and access (water, poverty and gender) and ICM strategies plus Final presentations

10.00–10.30	COFFEE BREAK

Time	Session Details		Session Facilitation
10.30-12.00	SESSION 9: Working group presentations of outcomes and adoption of conclusions and recommendations		Session Chair
	10.30–11.30	Working group presentations (15 minutes each) followed by plenary responses	
		Group 1: Water scarcity adaptation strategies for vulnerable rural communities	
		Group 2: Water storage for climate change adaptation (recovering rainwater)	
		Group 3: Water governance and water sector reform	
		Group 4: Equitable distribution of water rights and access (water, poverty and gender)	
	11.30–12.30	Review and adoption of seminar outcomes:	
		Seminar summary: key conclusions, recommendations and messages	
12.30–14.00	LUNCH BREAK		
15.00–16.30	SESSION 10: Official Closing Ceremony		Session Chair
	A joint closing session for all four CTA week events		
	15.00–16.30	Official Closing Ceremony	
		Key Messages: CTA Annual Seminar 2010	
		Key Messages: 9th Advisory Committee Meeting on Science and Technology	
		Key Messages : CTA ICT Observatory	
		Key Messages : Agriculture, Rural Development and Youth in the Information Society (ARDYIS)	
		Vote of Thanks: Mrs Oumy Ndiaye, Head, Communication Services Department, CTA, The Netherlands	
		Overview of CTA Week: Mr Michael Hailu, Director, CTA, The Netherlands	
		Closing remarks: Dr Ibrahim Mayaki, CEO, NEPAD/NPCA, South Africa	
		Guest of Honour	
16.30	End of the seminar and CTA/NEPAD week in South Africa		
	Refreshments		

NOTES

The Technical Centre for Agricultural and Rural Cooperation (CTA) was established in1983 under the Lomé Convention between the ACP (African, Caribbean and Pacific) Group of States and the European Union (EU) Member States. Since 2000, it has operated within the framework of the ACP–EU Cotonou Agreement. CTA's tasks are to develop and provide products and services that improve access to information for agriculture and rural development, and to strengthen the capacity of ACP countries to acquire, process, produce and disseminate information in this area.

Nepad Planning and Coordination Agency (NPCA).

The New Partnership for Africa's Development (NEPAD) is a programme of the African Union (AU) adopted in Lusaka, Zambia in 2001. NEPAD is a radically new intervention, spearheaded by African leaders to pursue new priorities and approaches to the political and socio-economic transformation of Africa.

In February 2010, the 14th AU Assembly established the NEPAD Planning and Coordinating Agency (NEPAD Agency) as a technical body of the AU to replace the NEPAD Secretariat. The NEPAD Agency is a key outcome of the integration of NEPAD into the AU structures and processes.

The core mandate of the NEPAD Agency is to facilitate and coordinate the implementation of regional and continental priority programmes and projects and to push for partnerships, resource mobilisation and research and knowledge management.

CTA
Postbus 380 – 6700 AJ Wageningen
The Netherlands
T: + 31 317 467 100
F: + 31 317 460 067
cta@cta.int
www.cta.int

NEPAD Planning and Coordinating Agency
Agence de Planification et de Coordination du NEPAD

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