SWEETFUEL NEWS – JULY 2012

The SWEETFUEL project - Sweet Sorghum: An alternative energy crop

The project SWEETFUEL is supported by the European Commission in the 7th Framework Programme to exploit the advantages of sweet sorghum as potential energy crop for bioethanol production. Thereby, the main objective of SWEETFUEL is to optimize yields in temperate, sub-tropical and tropical regions by genetic enhancement and the improvement of cultural and harvest practices.

The duration of the SWEETFUEL project is from January 2009 until December 2013. Information on the project is available at the website **www.sweetfuel-project.eu**.

The SWEETFUEL partnership is coordinated by the Centre International en Recherche Agronomique pour le Développement (CIRAD) from France and comprises the following 10 partners from research, academia and industry:

- CIRAD (coordinator), France
- ICRISAT - International Crops Research Institute for Semi-Arid Tropics, India
- EMBRAPA Maize and Sorghum, Brazil
- KWS SAAT AG, Germany
- IFEU Institute, Germany
- Universita di Bologna (UNIBO), Italy
- Universita Cattolica del Sacro Cuore (UCSC), Italy
- Agricultural Research Council (ARC) – Grain Crop Institute, South Africa
- Universidad Autónoma de Nuevo León (UANL), Mexico
- WIP Renewable Energies, Germany

The SWEETFUEL project activities are implemented along the following work packages (WP).

- WP1: Breeding for temperate environments
- WP2: Breeding for drought prone environments
- WP3: Breeding for low-fertility soil environments
- WP4: Functional analysis of adaptation and productivity traits
- WP5: Cultural practices and crop modelling
- WP6: Integrated sustainability assessment
- WP7: Dissemination of results

This SWEETFUEL NEWSLETTER presents information on recent results within WP2 on “Breeding for drought prone environments”, WP3 on “Breeding for low-fertility environments”, WP5 on “Cultural practices and crop modelling”, WP6 on “Integrated assessment” and “SWOT analysis”, as well on “Ethical issues”.

WP2 – Breeding for Drought Prone Environments

Work Package Leader: International Crops Research Institute For The Semi-Arid Tropics (ICRISAT), Patancheru, Andhra Pradesh, 502 324, India

Partners: Agricultural Research Council – Grain Crops Institute (ARC-GCI), Potchefstrom, South Africa and Universidad Autonoma De Nuevo Leon (UANL), San Nicolas de los Garza, Mexico.

In the following recent research results in India, Mexico and South Africa within WP2 on "Breeding for Drought Prone Environments" are briefly presented.

I. Seed increase and exchange of germplasm

Twenty promising improved sweet sorghum cultivars and hybrid parents were multiplied at ICRISAT in India (Figure 1), whereas 38 sweet sorghum cultivars, parental lines and hybrids are being multiplied at ARC-GCI in South Africa. Seed multiplication of eight hybrids and their parents is being done at UANL in Mexico.

Figure 1: Seed multiplication of promising sweet sorghum entries in ICRISAT, Patancheru, India

II. Multilocation testing to identify promising hybrids

A total of 17 sweet sorghum entries (nine varieties and four hybrids) were tested in a multi-location trial to select best varieties and hybrids for terminal stress in 2011 post-rainy season. The multi-location trial (MLT) was planted in three replications in a randomized complete block design (RCBD) at three different geographical locations of India *viz.,* ICRISAT- Patancheru, Andhra Pradesh; Regional Agricultural Research Station (RARS), Nandyal, Andhra Pradesh (Figure 2) and Agricultural Research Station (ARS), Gangavati, Karnataka (Figure 3).

The following four checks were used for the trials: ICSV 93046 (sweet sorghum variety), CSH 22 SS (sweet sorghum hybrid), E 36-1 (drought tolerant check) and R 12 (drought susceptible check).

The G x E interaction was highly significant for days to 50% flowering, plant height, stalk weight, juice weight, brix (%) and sugar yield. Three entries, i.e. OPV 17, ICSSH 47 and ICSV 25311 had recorded higher sugar yields compared to the best check ICSV 93046. Sugar yield in the entries tested varied from 0.3 to 2.3 t ha^{-1} (ICSV 93046: 1.6 t ha^{-1}).

Figure 2: MLT at Regional Agricultural Research Station (RARS), Nandyal, Andhra Pradesh, India

Figure 3: MLT at Agricultural Research Station (ARS), Gangavati, Karnataka, India

A total of 19 sweet sorghum entries (eleven varieties and four hybrids) were tested in a multi-location trial to select best varieties and hybrids for mid-season moisture stress in 2011 post-rainy season in three locations (Patancheru, Nandyal and Gangavathi). Five entries, i.e. ICSV 25300, ICSV 25299, ICSV 25315, OPV03 and ICSSH 19 (1.6-1.9 t ha^{-1}), had higher sugar yields compared to the best check ICSV 93046 (1.3 t ha^{-1}).

At UANL, Mexico, twelve genotypes (three from South Africa, three from México and four from India plus two checks) were planted in three different locations in the Northern part of México (Ébano, San Luis Potosí; Marín, Nuevo León and Río Bravo, Tamaulipas). The objective was to evaluate improved sweet sorghum cultivars from partner countries (India, Mexico and South Africa) in Mexican conditions. One experiment was already harvested at the end of May (Ebano) and the other two were harvested by the first week of July.

At ARC-GCI, South Africa, MLTs were conducted at Potchefstroom (Figure 4) at the locations Taung and Lutzville and promising cultivars were identified.

Figure 4: Mid-season stress trial at Potchefstroom, ARC-GCI, South Africa

III. Post-rainy season adapted improved hybrid parents

A total of 19 genotypes comprising sweet sorghum hybrid parental lines, hybrids, varieties and germplasms accessions were evaluated along with five checks (ICSV 112: high grain yielding variety, R 16: drought susceptible check, B 35: stay green (drought tolerant) check, E 36-1: both stay green and sweet sorghum variety and NTJ 2: sweet sorghum variety) in RCBD with three-replications during post-rainy season 2011 at ICRISAT-Patancheru.

The top five lines and their superior sugar yields are: SP 08 16447-2 (2.6 t ha^{-1}), SP 08 2061-2 and SP 08 16421-2 (2.0 t ha^{-1}), SP 08 16427 (1.8 t ha^{-1}) and SP 08 16440 (1.7 t ha^{-1}).

IV. SWEETFUEL team visit in India 2011

In October 2011, SWEETFUEL team members (Serge Bracconnier, Gilles Trouche, Guido Reinhardt, Marcel Burtzyn and P. Srinivasa Rao) visited ICRISAT and had interactions with sweet sorghum farmers of Maharashtra, India (Figure 5).

The hybrid CSH 22 SS in farmers' fields recorded up to 45 t/ha stalk yield with a Brix% of 16.5% and grain yield of 2.0 t/ha. The farmers are willing to take up sweet sorghum cultivation in large scale, however their enthusiasm is dampened due to the fact that there currently is no large scale distillery in operation in India.

Figure 5: SWEETFUEL team with sweet sorghum farmers of Maharashtra, India

WP3 – Breeding for Low-fertility Environments

Work Package Leader: EMBRAPA Maize and Sorghum, Brazil

Partners: Agricultural Research Council – Grain Crops Institute (ARC-GCI), South Africa and CIRAD, France

In recent years the demand for sweet sorghum as raw material for ethanol production in Brazil has increased considerably. Thereby, sweet sorghum is being proposed to be planted at the beginning of the rainy season in areas of sugarcane renovation to increase the period of operation of large distilleries in Brazil by up to 100 days (Figure 1). Thereby, advantage is taken from the **good complementarity of the crop cycles** of sweet sorghum and sugar cane.

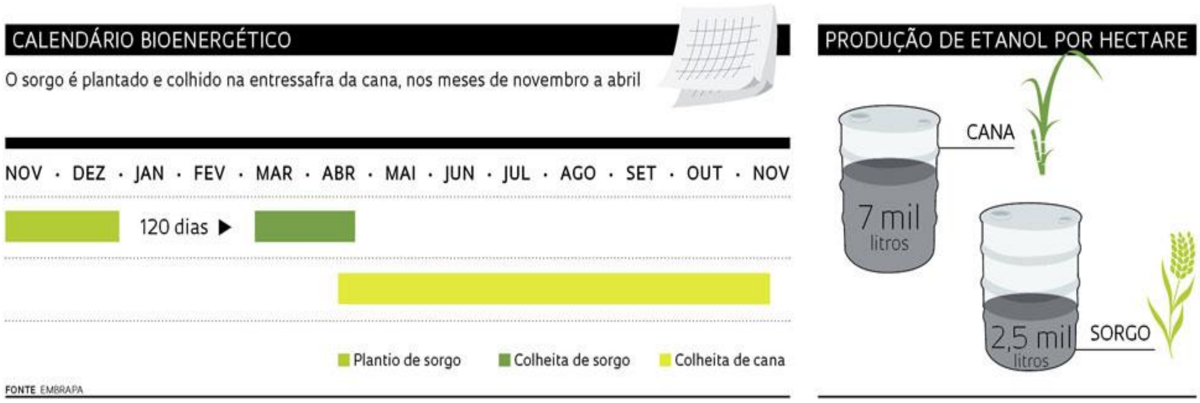

Figure 1: Calendar showing planting and harvesting periods of sweet sorghum and sugar cane (EMBRAPA)

Furthermore, harvesting of sweet sorghum can be done with **adapted sugar cane harvesters** (currently, in Brazil the panicle is not harvested), and existing equipment for crushing stalks, extracting juice, and fermentation can be used for the processing of sweet sorghum. In Figure 2 sweet sorghum production systems (planting and harvesting) for industrial ethanol production are presented.

Figure 2: Sweet sorghum industrial production system (top: planting; bottom: harvesting) (EMBRAPA)

It is estimated that about 20% of the current 9 million hectares of sugar cane can be cultivated with sweet sorghum leading to a very large **potential of 1.8 million hectares** for sweet sorghum plantations in areas of sugar cane renovation. In addition, this demand is expected to double in the next 20 years. Thus, there is potential demand for 12-14 thousand tons of sweet sorghum seeds which currently cannot be satisfied with seeds of suitable quality.

A recent economic study in Brazil indicated that a 15 day sweet sorghum milling period before sugar cane harvesting beginning in April is profitable with yields of 2500 to 3000 litres of ethanol per hectare. However, pilot studies in Brazil with experimental hybrids only produced less than 1500 litres per hectare. Therefore, great efforts have to be taken to improve the yield of sweet sorghum and Dr. Robert Schaffert from EMBRAPA underlines the importance of a minimum Brix level of > 16-18%.

In the framework of WP3 "Breeding for Low-fertility Soils" research is performed on yield and quality improvements, production of high-quality seeds, improvement of crop management, as well as biomass production systems.

A video by EMBRAPA on the production and harvesting of sweet sorghum as complement to sugar cane is available at the SWEETFUEL website under the link: http://www.sweetfuel-project.eu/sweetfuel_events/complementation_of_sugar_cane_by_sweet_sorghum_in_brazil

WP5 – Cultural Practices and Crop Modelling

Work Package Leader: University of Bologna (UNIBO), Italy

Partners: Agricultural Research Council – Grain Crops Institute (ARC-GCI), South Africa, Centre International en Recherche Agronomique pour le Développement (CIRAD), France, and Universidad Autonoma De Nuevo Leon (UANL), Mexico.

Field and controlled environment trials were carried out in Mexico (UANL), South Africa (ARC-GCI), and Italy (UniBO) in order to assess the yield response of newly-selected genotypes and commercial hybrids to different N fertilization rates, and to cold and water stresses. Appropriate harvest techniques and storability methods were also tested within WP5. The preliminary results of these activities are summarized below. In addition a crop model for simulating different genotype management practices under variable climatic conditions is being calibrated and validated by CIRAD to draw out different production scenarios and associated risks.

I. Field trials

a) Nitrogen

In general the N fertilization trials carried out in Mexico and South Africa seem to indicate that sweet sorghum response to elevated N fertilization rates is not that high. The average fresh biomass production of 10 genotypes under five N fertilization doses (0, 40, 80, 120, 300 kg N ha^{-1}) and one micorrhizal treatment did not show large differences in a spring trial in Mexico. However, biomass production was significantly different among the tested genotypes.

The most productive genotypes were FAUANL 37 A x FAUANL 39 and Keller with their highest yields under 0 and 40 kg N ha^{-1}, respectively. The N fertilization trials carried out in South Africa (0, 30, 60, 90, and 120 kg N ha^{-1} x two locations x three cultivars) somehow followed a similar trend. The main results indicate that in many instances the lower N applications rates produced better than the higher fertilization rates. For example, biomass production at one location (Vaalharts) was the highest with a 60 kg N ha^{-1} application while the lowest biomass yield obtained was with 90 kg N ha^{-1} at Wilgeboom. The confirmation of these results will come from follow up trials that have already been established in both countries.

Picture 1. Field experiment of Nitrogen doses. Summer 2011. Marin, Nuevo Leon, México

b) Cold tolerance

In order to understand the adaptability of sweet sorghum to cold conditions and early sowing under temperate climates, the response of three commercial hybrids to four sowing times was evaluated in a field trial by UniBO. All three hybrids showed an increased emergence speed as the soil temperature increased due to the advancement of the season from early to the end of spring. The range of days to full emergence at the coldest sowing dates (24 March and 7 April) was 16-17 days, while at the hottest sowing time (9 May) plants required about 10 days to emerge.

Moreover, later sowing resulted in faster growth in plant height, but no significant differences among hybrids were found. On the other hand, at early sowing times the Bulldozer hybrid showed significantly higher growing rates than the other two hybrids. In addition Bulldozer produced the highest dry biomass when sown early in the season. However, early sowing was inversely related to the stem elongation rates, indicating that the adaptability of Bulldozer to cold (early sowing) is better explained by a higher accumulation of biomass and that higher elongation rates do not offset the longer growing period.

Picture 2: Sowing dates field trial, Bologna, Italy

II. Controlled environment trials

a) Cold tolerance

UniBO evaluated the effects of cold stress on emergence, growth rates, and physiological activity of 30 sweet sorghum genotype seedlings under controlled environmental conditions. A better understanding of such traits across different genotypes will improve our knowledge of low-temperature stress tolerance and related adaptation physiological mechanisms at the establishment phase. Four temperature treatments at sowing time using a 12/12 h day/night cycle were implemented: 7/5, 9/7, 13/10, and 15/11 ^{o}C.

Significant genotypic differences were found for all traits evaluated. A significant negative correlation between mean emergence time and soil temperature was found, while emergence percent was positively correlated to soil temperature increases. Moreover, plant photosynthetic vitality (characterized by the performance index which is an integrative parameter of the photosystem II efficiency derived from fluorescence measurements) was significantly and positively correlated with each of the aforementioned traits, indicating that chlorophyll a fluorescence could be used for screening cold tolerance in sweet sorghum genotypes.

Picture 3: Cold tolerance trial in a growth chamber, Bologna, Italy

b) Drought resistance

UniBO also evaluated the drought resistance of two genotypes identified among most cold resistant genotypes in the previous study. The trial was set up in a total of 20 rhizotrons where calibrated soil moisture probes were installed for monitoring and adjusting the soil moisture content in the well-watered and dry treatments to 25% and 12% (v/v), respectively.

The main results show that under drought conditions the ZN8M-50003/002 genotype had higher ability than the ZN8M-50006/001 genotype to sustain its physiological activity closer to that of its control. Moreover, the droughted ZN8M-50003/002 genotype had higher leaf area index and aboveground biomass ratios than the ZN8M-50006/001 genotype. These results suggest that the ZN8M-50003/002 genotype have higher ability to resist drought, especially at early growth stages.

Picture 4: Drought resistance trial in rizhotrons, Bologna, Italy

c) Harvest and storage techniques

Based on last year's results which indicated that the best harvest time for maximizing structural carbon and ethanol or energy yields is between milk stage and hard dough stage, the follow up study was related to the evaluation of two harvest methods in combination with fructophilic (Bayanus) and glucophilic (Fermiblac) yeasts in order to restart stuck ferments and improve the fermentation efficiency of the extracted juice. A new continuous screw press system was used to extract the stems' juice. The results of this trial are in progress.

Picture 5: Continuous screw press, Bologna, Italy

WP6 – Integrated Assessment

Work Package Leader: IFEU Institute, Germany

Partners: CIRAD, France, ICRISAT, India, and WIP Renewable Energies, Germany

The main objective of work package 6 "Integrated assessment" is to provide a multi-criteria evaluation of the sustainability of the sweet sorghum production and use routes taking into account technological, environmental, economic and social aspects. This integrated assessment of sustainability will generate optimized sweet sorghum production and use systems.

With this, the "Integrated assessment" will provide a full appreciation of the various impacts on sustainability of the sweet sorghum production and use chains and alternative production systems for biomaterials, food, fibres and biofuels. Importantly, this analysis will clearly establish to what an extent the activities on sweet sorghum improves the current state of sweet sorghum production and use patterns and how the benefits and/or limitations of this advanced approach compare to other concepts such as the production of competing biofuels or producing food, feed and/or fibres. On this basis, the most promising sweet sorghum routes will be depicted in terms of being most sustainable.

The sustainability assessment in the SWEETFUEL project takes into account all so-called "three pillars" of sustainability. The most well-known definition of sustainability can be found in the report of the Brundtland Commission: 'sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs'. At the 2005 World Summit it was noted that this requires the reconciliation of environmental, social and economic demands – which has been defined to be the "three pillars" of sustainability. This view has been expressed as a scheme using three overlapping ellipses indicating that the three pillars of sustainability are not mutually exclusive and can be mutually reinforcing (Figure 1).

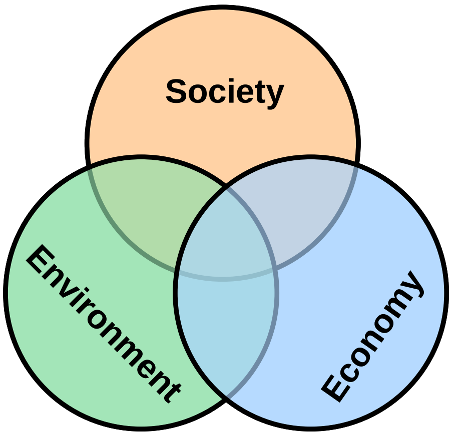

Figure 1: Scheme of sustainable development: at the confluence of three constituent parts /UN 2005/

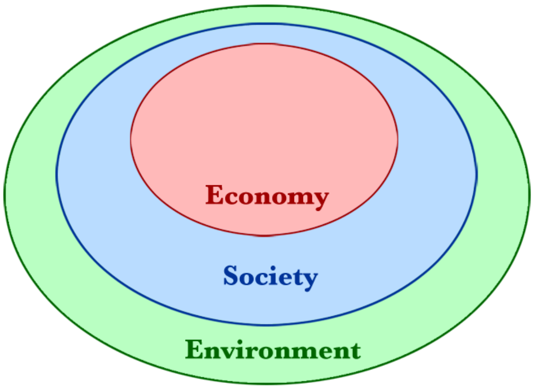

Figure 2: Scheme indicating the relationship between the three pillars of sustainability /Scott Cato 2009/

The UN definition is not universally accepted and has undergone various interpretations. For many environmentalists the idea of sustainable development is an oxymoron as development seems to entail environmental degradation. From this perspective, the economy is a subsystem of human society, which is itself a subsystem of the ecosphere, and a gain in one sector is a loss from another. This can be illustrated as three concentric circles (Figure 2). In the course of the project it was concluded, that both of these interpretations will be covered by the work being done. Another result of the work done so far is the definition of key questions which will be answered by the integrated assessment next to the core question "Which are the best ways to produce and use sweet sorghum for energy from an environmental, economic and social point of view?"

- How should the sweet sorghum products be used from a sustainability point of view?
- What is the influence of different environmental and climatic conditions, like tropical and temperate climates, on the overall results and where should sweet sorghum be cultivated and used?
- What is the influence of different usage pathways for the by-products on the overall results and which usage shall be preferred from a sustainability point of view?

- What are the differences of the results between decentralized and centralized energy production from sweet sorghum and which options should be preferred from a sustain-ability point of view?
- What is the relative importance of various life cycle steps on the overall results and which optimization potentials can be identified from a sustainability point of view?

In the course of the project it was decided that the analysis takes into account the entire life cycle ("life cycle thinking"), from the "cradle" (= biomass cultivation) to the "grave" (e.g. end-of-life treatment) of the biomass, (Figure 3). This accounts for all tasks of the work package being:

- Technological assessment
- Environmental assessment
- Economic assessment
- SWOT analysis (on strengths, weaknesses, opportunities and threats)
- Integrated assessment

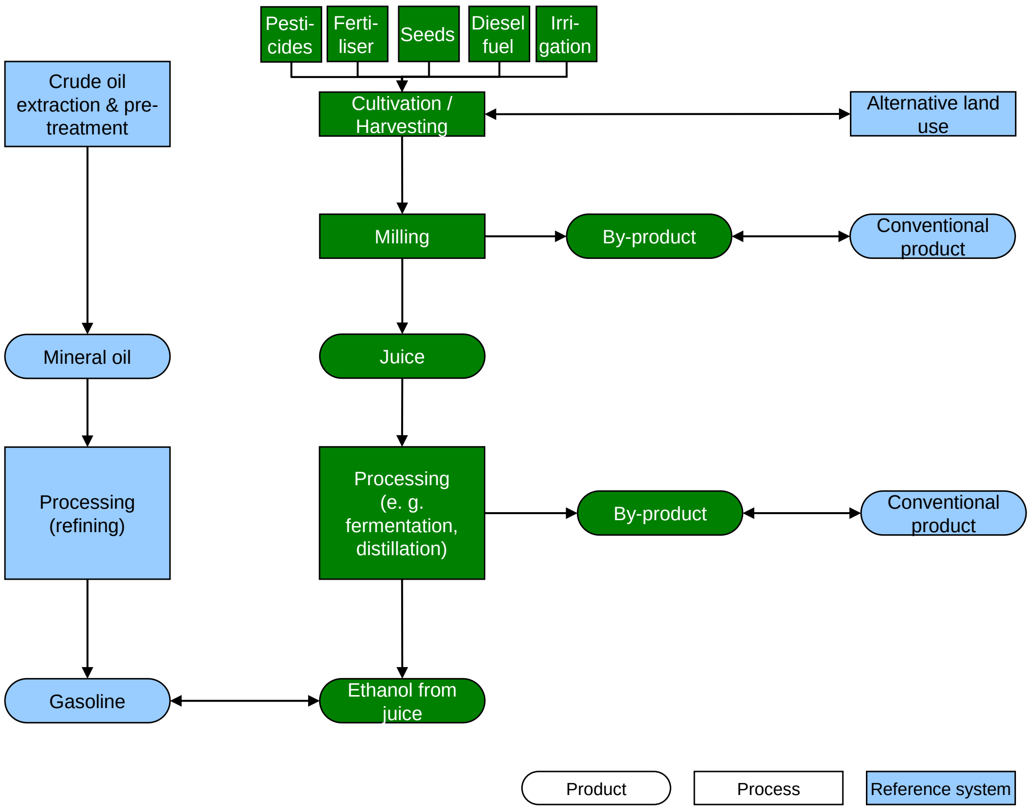

Figure 3: Sustainability assessment in SWEETFUEL: The concept of life cycle assessment

In detail, the life cycle comparisons include hundreds of scenarios for sweet sorghum production and use which have been defined and agreed upon by the consortium. They include sweet sorghum production in temperate, semi-arid and tropical climate, for first and/or second ethanol production schemes, grain use for food or biofuel, biogas production, use of bagasse for fuel, feed or bioenergy, different by product uses, different land use scenarios et cetera. Details can be found in the relating publications.

Concerning all tasks listed above, results will be presented in the next newsletter. For interim results, we refer to the SWEETFUEL homepage which contains all publicly available deliverables, interim results, presentations and related publications with respect to work package 6.

WP6 – Integrated Assessment – SWOT Analysis

Task Leader: WIP Renewable Energies, Germany

Partners: IFEU Institute, Germany

In order to get an overview of advantages and disadvantages of different sweet sorghum value chains a SWOT (Strengths, Weaknesses, Opportunities, and Threats) analysis is conducted in the framework of WP6 "Integrated Assessment". Thereby, the analysis investigates several sweet sorghum value chains under different framework conditions: subtropical, tropical and temperate climate. The value chains include the cultivation of sweet sorghum, conversion to different products and end use of the products. A main focus of the SWOT analysis is on sweet sorghum in developing and emerging countries.

The objective of the SWEETFUEL sustainability analysis is **to identify the best pathways to produce and use sweet sorghum as energy crop from an ecological, economic and social point of view**.

The SWOT analysis is a tool to contribute to this objective. Results of the SWOT analysis shall help in decision making processes for improved sweet sorghum value chains in different climates and framework conditions in order to:

- ensure competitiveness/complementary with other energy (bioethanol) crops
- ensure competitiveness with fossil based energy/products
- guarantee environmental, social and economic sustainability

The SWOT analysis describes the state-of-the-art of sweet sorghum chains in order to formulate optimisation strategies for sweet sorghum production and use pathways. Also potential future developments are considered and integrated in the SWOT analysis. Thereby, the timeframe includes the years 2014 (the real situation at the end of the SWEETFUEL project) and 2020 (expected future based on conservative assumptions).

The following analyses are made and described in dedicated chapters:

- General SWOT for sweet sorghum
- Subtropical and tropical climate
    - Centralised production system (cultivation and conversion)
    - Decentralised syrup production system (cultivation and conversion)
    - Decentralised ethanol production system (cultivation and conversion)
- Temperate climate
    - Biogas production system (cultivation and conversion)
    - Lignocellulose-ethanol production system (cultivation and conversion)
    - Direct combustion system (cultivation and conversion)
    - Gasification system (cultivation and conversion)

The first draft of the SWOT analysis was finalised in May 2012 which is currently subject to an expert consultation involving external stakeholders. For this, contributions are requested on the following questions:

- What are the general strength/opportunities of sweet sorghum as energy crop?
- What are the general weakness/threats of sweet sorghum as energy crop?
- What are the main socio-economic advantages of sweet sorghum cultivation and use in developing countries?
- What are the main socio-economic problems of sweet sorghum cultivation and use in developing countries?
- What are the main environmental advantages of sweet sorghum cultivation and use in developing countries?
- What are the main environmental problems of sweet sorghum cultivation and use in developing countries?
- What are the most important products of sweet sorghum in developing countries?
- Should sweet sorghum as energy crop (for ethanol production) be promoted in developing countries?

Based on the results of the expert consultation the SWEETFUEL SWOT analysis will be revised and up-dated, and the final report will be available on the project website www.sweetfuel-project.eu by autumn 2012.

Ethical Issues

Task Leader: Marcel Bursztyn, University of Brasilia, Center for Sustainable Development, Brazil

In the framework of the SWEETFUEL project specific attention is given to ethical issues arising from the implementation of sweet sorghum as an energy crop. At a recent project meeting in Hyderabad, India, the following questions were raised with respect to the interaction between peasants and researchers:

- In **economic** terms (risks of a negative cost-benefit balance not only for the research institutions, but mainly for users of the knowledge generated by SWEETFUEL);
- **For the farmers**, increase in their costs by the payment of royalties included in the acquisition of new technological standards. Up to what extend they are partners, as they are providing their traditional knowledge and seeds? As partners, which rights do they have?
- In **environmental** terms, questions involving soil, water or the use of chemicals were mentioned;
- In **cultural** terms, changes in lifestyles as consequence of a deeper integration to market rules were mentioned. How can we be sure about the risks of this process, considering the traditional pattern of economic decisions of peasants?
- Doubts about **informed consent**.

From the institutional point of view, the discussion considered issues such as:

- The relation among partners within the SWEETFUEL (asymmetries? imbalances?). The fact that partners work in a rather autonomous way has been mentioned by the ICRISAT team as a key reason for the good relation among them as institutional differences can be minimised;
- The share of credits related to authorship;
- Propriety rights;
- Conflict of interests (such as open access to the results vs. payment of royalties vs. commercialisation of the outcomes of SWEETFUEL).

On the implementation of the strategies of SWEETFUEL, considering the involvement of 400 farmers in the process:

- A solid sample for the understanding and follow-up, as they were previously involved with the ethanol industry for 3 years
- The industry provides seeds and inputs (with costs included in the deal)
- Risks, as the harvest can be bad, for several reasons
- The price paid by the industry is independent of the final quality of the material provided (the payment is strictly based on quantity)

Some risks which do not necessarily derive strictly from SWEETFUEL:

- What is the guarantee that those initiatives will be “sustainable” in terms of **continuity**, after the end of the “incubation”?
- How is the training of **local leaderships** to carry on the experiences, after the end of the projects?
- Is there a sociological/anthropological follow-up, so that the sense of “**ownership**” and “**responsiveness**” can be assured?
- What are the possibilities of **disseminating** those experiences in a **larger scale**? (from the “lab” to the real world)
- How to involve more industries in the process?
- Is there a capacity building strategy so that the peasants involved can run their own management of the initiative? (**self sufficiency**)
- Is there a scheme for the deployment an **ex post assessment** (for instance 3 years after the end of this initial “incubation”), so that the overall sustainability can be effectively checked?

Finally, a survey was proposed to the partners of the SWEETFUEL project which is based on a recent survey performed in Brazil among employees of EMBRAPA. The following questions are included in the questionnaire:

1. Do you see any relation between the SWEETFUEL project and food safety risks?
2. Do you see any relation between the SWEETFUEL project and bio-safety risks?
3. Do you see any relation between the SWEETFUEL project and risks of environmental damage?
4. Do you see any relation between the SWEETFUEL project and social risks?
5. Do you see any relation between the SWEETFUEL project and economic risks?
6. Do you see any relation between the SWEETFUEL project and conflicts of interest?
7. Do you see any relation between the SWEETFUEL project and problems of informed consent?
8. Do you see any relation between the SWEETFUEL project and problems with the sharing of results?
9. Do you see any relation between the SWEETFUEL project and the sharing of benefits?
10. Do you see any relation between the SWEETFUEL project and problems of authorship of publications?
11. Do you see any relation between the SWEETFUEL project and problems in addressing specific national regulations?
12. Do you consider important to inform decision makers and / or users on possible implications or risks of adopting the results of your research?
13. Have you done it before (to inform decision makers and / or users on possible implications or risks of adopting the results of your research)?
14. Have you ever felt yourself as victim of some kind of ethical deviation?
15. In your research unity, have you heard or noticed any ethical misconduct by another researcher?
16. As a researcher did you ever have any conduct that you now understand as ethically wrong?
17. Have you ever felt that your research work was being hampered or limited by ethical regulations in general (norms defined outside the research centre) or deontological procedures (rules or code of ethics of own centre) in particular?
18. Do you think agricultural research in general, as a field of scientific and technological development is susceptible to conflicts of interest?
19. If you feel there is an ethical misconduct by one of your fellows or if you notice that your research is leading to ethical conflicts, what would be your reaction?
20. If you identify any other ethical issue concerning the SWEETFUEL project, which you consider relevant, please describe it briefly.

SWEETFUEL Contacts

SWEETFUEL NEWS publications aim to provide recent information on activities and results of the SWEETFUEL project to interested stakeholders worldwide. In the framework of the SWEETFUEL project an associate partnership has been established to provide opportunities for cooperation and knowledge exchange with international stakeholders. Interested stakeholders are invited to join the SWEETFUEL partnership by signing an application form available at the website www.sweetfuel-project.eu.

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