The value web approach – so that the South can also benefit from the bioeconomy

The rising demand for biomass is transforming agriculture from a food to a complex biomass-supplying and -processing sector, which the countries of the South could benefit from. New prospects could arise for them to go beyond their role of pure raw material suppliers. However, a value chain approach is insufficient in this context. The biomass-based value web appears to offer an alternative approach.

The increasing global demand for biomass, as primary agricultural products and feedstock for various forms of usage, has started to change the global agricultural production and price structure. Studies conclude that the high demand for biofuels in the USA and European Union was the most crucial factor for the emergence of the food price crisis in 2007/8.

However, on bioenergy's coat-tails, biomass demand for other uses has increased: Substituting biomass-based products for crude oil-based products in various industrial areas is – if not yet in mass-production – in its experimental phase. For instance, the market for biomass-based plastic is growing. The Coca-Cola company is already using 30 per cent biomass-based PET plastic, while Toyota and other car brands have started to replace oil-based plastic for cars with bioplastics. This rise in global biomass demand is an opportunity for many agricultural-based, low-income economies to diversify their economy. Yet, concerns prevail that producing more and diversified non-food crop biomass commodities will compete with domestic food production and perpetuate these countries' status as mere suppliers of raw materials. Three strategies may counter these concerns:

1) The countries involved have to ascertain the priority of ensuring or improving the status of food security at national, regional and local level while taking advantage of emerging bioeconomies world-wide. To achieve this, the focus should be on labour-intensive, job-creating crops, production and processing. Another approach is the certification of the production of all types of biomass (food, feed, fuel, fibre, etc.), whether exported or nationally used, for not being in conflict with food and nutrition security, preferably in combination with a global monitoring of the impact of non-food biomass use on food security.

2) The agrarian-dominated economies will benefit significantly more from the increasing demand for biomass if major parts of the value addition to the raw product "biomass" take place domestically in a labour-intensive processing sector.

3) To prevent excessive pressure on natural production resources, a sustainable productivity increase has to be part of the emerging bioeconomy, partly through sustainable biomass production intensification, but also through efficiency gains in all required post-harvest, processing and trading activities.

The old dilemma: biomass only becomes valuable through processing

Where and how much value is best added to biomass-based products is an old discussion within the development community. Even today, the majority of low-income, agrarian-dominated countries are not fully exploiting processing opportunities for their biomass-based products exported to other countries.

The **cut-flower** industry in Eastern Africa is a good example of how value addition through processing (mainly handling in this case) can take place in the country of biomass production. Due to high labour requirements

Detlef Virchow, Tina Beuchelt, Manfred Denich
Center for Development Research (ZEF)
University of Bonn, Germany
beuchelt@uni-bonn.de

Tim K. Loos
Food Security Center (FSC)
University of Hohenheim, Germany

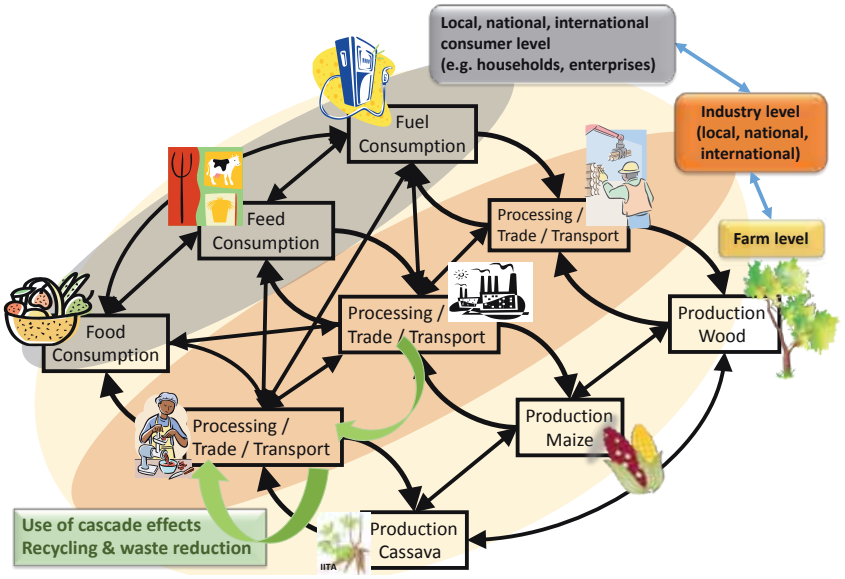
Marlene Hoppe
C.S.P. GmbH, Dresden, Germany

Arnim Kuhn
University of Bonn, Germany

Various automobile manufacturers have started to replace oil-based plastic with bio-based plastic – for example Mercedes-Benz chose the EcoPaXX polyamide produced by the Royal DSM Company for the engine beauty cover of the latest version of its A-Class family car.

Photo: Royal DSM

Simplified biomass-based value web



in the process, the local communities benefit from income earnings of locally hired workers. **Coffee** is an example where value addition through roasting fresh coffee for export is difficult in most producing countries. The national preferences regarding the type of roasted coffee are too diverse across customer countries, and roasted coffee cannot be stored for long time. However, regarding soluble (instant) coffee, several producer countries like India, Brazil, Thailand and Ecuador process coffee nationally and market up to 60 per cent of their total coffee exports as instant coffee. **Cotton** production and processing shows a more diverse picture: India, with the largest cotton cultivated area (about 30 % of the global cotton production area), has long had a strong textile industry employing up to 50 million people in cotton processing and trading, besides nearly six million farmers in cotton production. West Africa's cotton production has expanded over the last decade without the development of a significant domestic textile industry.

The crucial and most significant value addition in the international bioenergy value chain is taking place in the countries importing biomass for bioenergy utilisation. The biomass-exporting countries are not significantly upgrading their biomass before exporting. This tendency will most likely advance with the third and fourth generation of bioenergy sources and especially with further advanced processing technologies like biorefineries, which can efficiently use plant raw materials for processing as well as for energetic purposes, especially as residual materials from diverse sources can be used. For example, "integrated forest biorefineries" can be added to an existing pulp mill, as piloted in the USA. In addition to pulp and paper, the complex also produces renewable energy (heat, electricity and liquid fuels) and bio-products like special chemicals and other high-value materials from various sources of forest, low-cost agricultural materials and residues. Already today, modern pulp mills paving the way into such technology efficiency are net energy producers. The concept of bio-refineries is still in its infancy. Although the economic potential of bio-refineries has been realised, the conception and technology of a biorefinery has to be very precisely calculated before implementation. It includes a continuous provision of biomass to be processed and a well-established market for the processed products.

However, the more sophisticated the technologies, the higher the necessary investments in research and plant establishment are, the less likely that low-income, biomass-producing countries are able to incorporate these technologies and processing levels into their value addition processes of converting raw biomass into high-value materials. Reasons for the very limited value addition taking place in biomass processing in low-income, agrarian countries include a lack of technical infrastructure, skilled workers, and (national) financial instruments as well as an underestimation of the potential value of biomass products.

Broadening the approach: from value chains to value webs

The complexity of value chains of agricultural products is increasing significantly. With the evolving bioeconomy, especially the demand side for different biomass types will be branching out with impacts at the handling, processing and trading level leading to an augmented diversity of activities. The example of a modern pulp mill stated above demonstrates the growing complexity. This bio-refinery will adjust both the quantity (and quality) of the diverse biomass sources as input and the produced output depending on biomass availability and demanded products as well as the relevant prices, thereby optimising the plant's profit. The rising demand for food and non-food biomass transforms agriculture from a food to a biomass-supplying and -processing sector in which the utilisation of the various feedstock crops and intermediate products is more flexible than it was in the past. Part of this development is that especially at the processing and trading level, the recycling and cascading effects to utilise and reutilise biomass at a very high degree ("zero waste") will lead to merged value chains. Hence, it is no longer sufficient to analyse the system by following the conventional more (isolated and) linear, mainly product-focused value chain approach. Analytical perspectives are needed which cover the complex pathways of biomass which include but go beyond the concept of value chain analysis. Here the holistic concept of biomass-based value webs becomes instrumental.

A biomass-based value web approach utilises the 'web perspective' as a multi-dimensional framework to un-

derstand the interrelation and linkages between several value chains and how they are governed. Instead of depicting the pathway of one product and thus being in tendency more industry-oriented, the web approach captures the manifold products which are and can be derived from one biomass raw product and respectively looks at the whole product mix produced on family farms, the different value chains the households participate in and how they are and could be linked. The web perspective helps to explore synergies between these value chains, identify inefficiencies and pinpoint potential for sustainable productivity increases in the entire biomass-based value web of a defined local, national or international system. This includes the analysis of existing and potential recycling processes and cascading uses during the processing phase of biomass, which opens new opportunities to locally capture more of the value-added. The cascades of use and interlinking of value chains are instrumental to increase the efficiency of resources and the sector, reduce possible areas of competition between uses and to make use of innovation potential.

The web perspective also helps to better identify who participates and benefits in the value webs (e.g. men or women, small or large producers/processors, national or international actors) and who does not, in which activities and processes, and whether and how the actors co-operate and network with each other. This helps to identify missing links and actors needed, information gaps, and capacity constraints as well as governance issues and power relations. The analytical approach also contributes to identifying profit and other benefit distributions among the different actors and participants in the whole web. Thus, opportunities can be detected how and where more value could be captured in poor producing countries, how it could be more equitably distributed and where access to food through job and income generation can be increased.

Increasing the activities of the domestic processing industry for biomass products requires the political commitment of governments as well as international support. Technical and physical infrastructure, a skilled labour force, and financial instruments are part of the solution. Further research and investment in labour-intensive yet capital-saving processing technologies for biomass commodities in developing countries is important. In the long term, a sustainable domestic processing and value addition will also require that domestic demand and markets develop.

The emerging bioeconomies may help low-income, agrarian-dominated countries to generate jobs and income in the biomass producing, processing and trading sector, particularly in rural areas. The key challenges are to identify ways for poor countries and poor producers to take advantage of these opportunities, which types of biomass, processing and technologies offer a realistic chance for biomass producers and processors in these countries and how, at the same time, food security can be enhanced and poverty reduced. Further knowledge gaps exist where the respective value chains and value webs need adjustments and support to ensure that value addition not only stays in the producing countries but also contributes to improving the livelihoods of family farmers, to foster small and medium-sized processors and generate employment opportunities.

A biomass-based value web for Africa

The BiomassWeb project "Improving food security in Africa through increased system productivity of biomass-based value webs" provides concepts to increase the availability of and access to food in sub-Saharan Africa while attending growing demands for non-food biomass. The research project identifies biomass-based value webs and studies selected entry points to increase overall system productivity. This includes exemplary agronomic, technological and institutional innovations in production, processing, and utilisation of biomass-based goods to market more and higher-value food and non-food biomass. The concept is based on innovation system approaches, stakeholder participation, demand-driven research and development activities. The research region is the productive Sudanese savanna belt (Ghana, Nigeria) and the East African highlands (Ethiopia). Specific exemplary 'model' value webs will be studied based on cassava, maize, banana/plantain/enset and biomass derived from natural vegetation and agroforestry systems. The project is funded under the BMBF initiative GlobE (see pages 14–15).
For more information: ➤ **www.biomassweb.org**

Photo: M. Denich

The project also examines how small-scale farmers' typical diversified cropping systems can be integrated into a value web approach.