



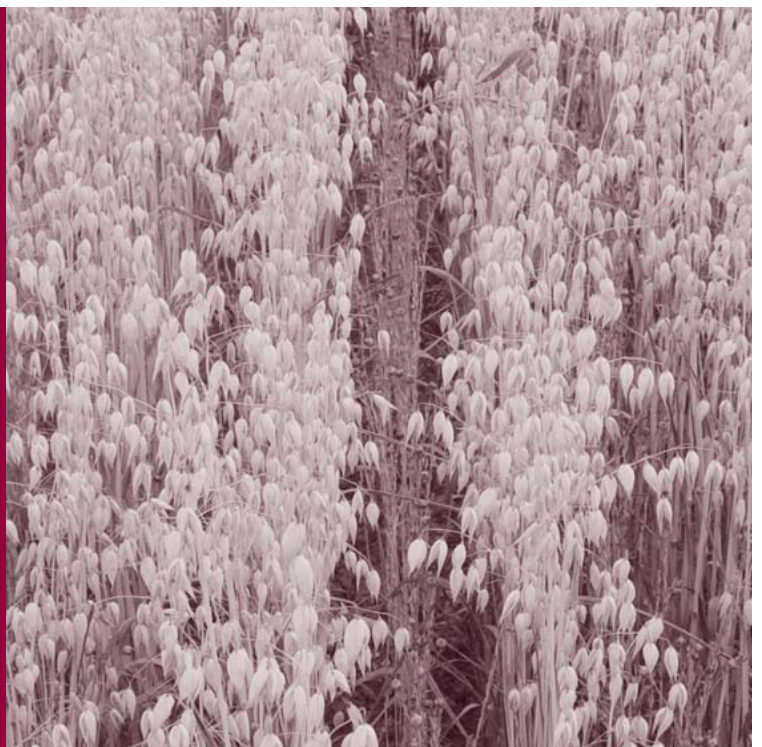
OFFICE OF TECHNOLOGY ASSESSMENT
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Alternative crop plants and methods of cultivation

Summary

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SUMMARY

In June 2003 the Committee on Education, Research and Technology Assessment decided to commission TAB with a TA Project on the subject of »Modern agrarian techniques and methods of production – economic and ecological potentials«. Based on a proposal made by the Committee for Consumer Protection, Food and Agriculture as well as suggestions from the rapporteurs, this TA project is to investigate what gains in efficiency could be achieved for a more sustainable agriculture through modern methods of production.

The present report on »alternative crop plants and methods of cultivation« forms a part of the final report of the »Modern agrarian techniques and methods of production – economic and ecological potentials« TA project. The partial report on »Precision Agriculture« will be presented simultaneously.

PRESENTATION OF THE PROBLEM

The investigation of modern methods of production should be carried out on the one hand on the basis of agrarian technological developments in the *Precision Agriculture* (PA) sector, and on the other hand in the light of new developments in *alternative crops and methods of cultivation* (such as e.g. mixed cultivation). The purpose of the investigation was to work out political options for action in the areas of research and technology policy, agrarian ecological policy as well as the agrarian policy framework.

Whereas with Precision Agriculture the emphasis lies on the sparing of resources, new methods of cultivation and alternative crops should first and foremost make a *contribution towards the preservation or the improvement of agricultural biodiversity*. On the subject of new methods of cultivation and alternative crops in crop farming – both with regard to *food production* as well as to *energetic and material use* – an overview should be created, upon which an investigation can be based into which of these are suitable for the exploitation of *new economic and ecological potentials* within the framework of sustainable agriculture in Germany under the stipulations of the new orientation of European agricultural policy.

In the light of the current state of development this report focuses its analysis on agricultural cultivation and breeding problems: These must first be resolved, before the perspectives for broader use are discussed in more detail.

ALTERNATIVE CROP PLANTS

By alternative crop plants this report is referring to agriculturally useful plants,

- > which are currently not grown or only grown on a very small scale in Germany,
- > which represent old crop species or species which have only relatively recently been cultivated from wild plants or which are used in other countries or regions to a certain extent,
- > which have been sufficiently developed and established for the methods of cultivation, so that an introduction into agricultural practice in Germany is in principle possible.

The description and discussion of the alternative crop plants is subdivided into *starch plants* (old wheat species, millet, buckwheat, amaranth, quinoa), *sugar plants* (chicory, Jerusalem artichoke), *oil plants* (Abessinian cale, gold of pleasure, safflower), *fibre plants* (fibre nettle), *medicinal and spice plants*, *dye plants as well as useful plants for energetic use* (sweet sorghum, Sudan grass, miscanthus, poplar, willow). The utilisation of crop plants both as foodstuffs as well as renewable primary products is also dealt with.

What all of the alternative crop plants discussed have in common is that they are not cultivated, or if so only on a very small scale. Accordingly these crop plants still display typical wild plant characteristics, including:

- > a low level of output;
- > *poor stability of yield*, i.e. substantial fluctuations in yield occur from year to year depending on the weather;
- > *irregular maturation*, which makes it difficult to determine an optimal harvest time (e.g. proso millet, buckwheat);
- > *high failure and crop losses*, whereby the potential yield is only partially exploited (e.g. buckwheat, amaranth);
- > *weed infestation* of subsequent crops caused by fallen seeds or root remnants (e.g. quinoa, Jerusalem artichoke).

Then there is also the fact that non-local plants such as the pseudocereals, Abessinian cale or safflower are acclimatised to warmer cultivation areas. This has adverse effects on the required germination temperature and the vegetation period in particular. On the whole there are *no varieties which are acclimatised to German habitats* available in the majority of cases. The breeding of alternative crop plants for a wide range of breeding purposes will thus remain important for the foreseeable future.

As a rule the cultivation techniques of comparable main crop species can be employed, so that no fundamental handicaps present themselves from this aspect. Scientific and practical knowledge of cultivation systems is however hitherto limited.

On the whole a significant expansion in the cultivation of alternative crop plants is not expected in the short term. Only in the medium to long-term may the *prospects for alternative crop plants* improve.

ECOLOGICAL ASPECTS

Most of the crop plants concerned are relatively undemanding and well suited for cultivation on lighter soils and sites tending towards dryness. They can be well integrated into the rotation of crops and would thus *increase the agricultural biodiversity* of these sites. As the alternative crop plants will not be able to compete with the crop plants predominant today on the high-yield sites for the foreseeable future, they also cannot contribute to higher agricultural biodiversity on the sites particularly affected by intensification and simplification of crop rotation.

The cultivation of medicinal and spice plants represents a particularly valuable contribution to the increase of agricultural biodiversity due to the small area required for cultivation of the respective species. The multiplier effect in the agrarian ecosystem is particularly apparent here: Biodiversity is not only enriched by the cultivation of different plant species, but rather as blossoming plants these provide attractive sites for numerous insects. However the positive effect of such niche production is slight when related to the total area. Amaranth and quinoa could prove problematic because of their relationship with problem weeds. There is not yet sufficient experience to draw conclusions e.g. on late weed infestation and on possible negative influences on biodiversity.

The *use of pesticides and fertilisers* would in general be *reduced* through alternative crop plants. With regard to the control of diseases and pests in particular, alternative crop plants bring about an expansion of the rotation of crops, which could also reduce the use of pesticides on market fruit. The undemanding nature of the alternative crop plants, their low level of output and their excellence for low-yield sites require an *extensive management*. In the areas where competitiveness over established crop plants can only be achieved through higher yields, such yield increases would certainly also lead to more intensive farming.



As the majority of the crop plants introduced here are summer annual crops, which in part also make high demands on soil management, they could cause *risks to the sustainable use of soil*, which in turn would require a scientific solution.

The competitive situation compared to fossil fuels and the existent conditions with culture crops *used for energy* lead to operating efficiency being more easily achieved through relatively intensive production methods. However in general fewer resources are required than is necessary in food production, as there are no appropriate quality requirements to be complied with. The problem of transport costs could result in a *stronger regional concentration* of individual species. The ecological evaluation of permanent crops such as miscanthus and short rotational plantations (poplar, willow) on agricultural areas is dependent on the ecological »opportunity costs«, therefore the alternative area use. Positive effects should ensue on intensively used farmland if site specific plants are chosen. In contrast the use of marginal sites carries with it on the one hand the threat of irreversible damage to valuable biotopes; on the other hand it opens the opportunity, applying appropriate cultivation methods, for an absolutely ecologically tolerant use in place of leaving land fallow.

Experience with non-local plants is not yet adequate generally speaking. This could mean that *the use of pesticides will be greater than expected with extensive cultivation*. Previous experience gained with very small scale cultivation however indicated a very minimal requirement for pesticides.

OPPORTUNITIES FOR USE, DEVELOPMENT STATUS AND PROSPECTS

In the efforts towards healthier nutrition a succession of old useful plants have been rediscovered in recent years as suppliers of primary products for foodstuffs, including millet and buckwheat. In addition endeavours have been made to improve agricultural biodiversity through organic farming, which has led e.g. to the cultivation of old wheat species. A growing interest in alternative crop plants also persists for use as a renewable primary product. A low level of output, a lack of varieties acclimatised to the habitat, little cultivation and different cultivation risks however lead to the situation that, generally speaking, alternative crop plants currently in Germany can not be *economically* cultivated.

Opportunities arise with alternative *starch plants*, for proso millet and pseudo-cereals in particular, as surrogates for cereal products for people suffering from celiac disease and neurodermatitis. The cultivation of the *millet* crop species can

be an interesting alternative for organic farms on light soils and sites tending towards dryness. Increasing demand has to date been almost exclusively met by imports. A greater interest in cultivation would boost research and breeding. Cultivation endeavours indicate potentials for suitable, stable yield varieties for farming in Germany.

In contrast the use of *amaranth* and *quinoa* is not yet beyond the experimental stage. The main barriers are the high temperature requirements and the long vegetation period. If an increasing demand for amaranth and quinoa develops in the human diet or as an industrial primary product, then large breeding efforts will be necessary. Alongside acclimatisation to the site conditions, there are technical characteristics such as particle size and threshability of the plants (regular maturation, reduction in crop losses) which would need to be improved.

Buckwheat can be introduced both in the area of conventional and of dietary foodstuffs. As it is devoid of gluten, buckwheat can be used for the production of gluten-free dietary products. The plant cultivation advantages as a cleaning crop in crop rotations are also favourable, particularly the control of nematodes. Buckwheat is a crop plant with compensation payment within the European Union. Its cultivation as a cereal has to date been sponsored through cereal subsidies. The decoupling of acreage payments by the most recent reform of the EU Common Agricultural Policy has not resulted in a significant change here, so that no substantial extension of cultivation can be expected.

In the foodstuffs area, the fructose yielded by the inulin from *chicory* or *Jerusalem artichoke* can be used as an alternative sweetener to sucrose. There are also various applications of inulin in the industrial sector which may yet gain in importance. Inulin can be used as a substitute for phosphate in detergents. The use of inulin as a culture medium for micro-organisms, which in turn produce organic acids, amino acids, antibiotics and vitamins is also of importance. Furthermore the biotechnological production of readily biodegradable plastics from inulin is possible.

Among the alternative *oil plants* there are both species which have industrial applications, such as Abyssinian cale due to its erucic acid content and gold of pleasure due to its linoleic and linolenic acid content, as well as species used in the foodstuffs sector, such as safflower with its high-grade »safflower oil«. An intensive search for alternative useful plants has developed in this sector in recent years. Above all this is fuelled by the interest of the chemical industry in replacing petroleum products. These plant species are fundamentally suitable for cultivation in Germany, but have in general yet to reach a level of economic



SUMMARY

efficiency. Abessinian cale was grown in the GDR as early as in the 1950s and 1960s. Central to its use today is its application in oleochemistry. Its oil contains approx. 50% erucic acid. Erucic acid is a versatile basic industrial material used as a plasticiser for plastics, for manufacturing lubricating oil, for manufacturing pharmaceutical products, for manufacturing paper and as a defoaming agent in detergents. In addition erucic acid is also used for chemical processes in oil extraction. Abessinian cale, as a summer oil plant, is however inferior to winter rapeseed in oil production per area. Apart from this there are cultivation risks with Abessinian cale for instance due to yield fluctuations and weed infestation.

Gold of *pleasure* is of interest because of the high oil content of its seeds. Due to its high proportion of linoleic and α -linolenic acid the oil is used primarily in the non-food-sector. Gold of pleasure oil is processed for the manufacture of paints and lacquers. Gold of pleasure oil can be further processed for the manufacture of cosmetic oils, creams, lotions and soaps. In addition it has limited suitability as fuel in oil engines. Gold of pleasure oil can also be processed into biodiesel (Methyl Ester). It can also be used as cooking oil and has here the status of a niche product. There are differing assessments as to the usefulness of the oilseed cake in animal feeding. For this reason oilseed cake is still classified as undesirable material in compound feedstuff. The growing of gold of pleasure in mixed cultivation can make a contribution to an increase in agricultural biodiversity, in particular on light soils and in organic farms. Yields recorded there are safe, even if they are low. The oilseed cake can also be used energetically in biogas plants.

Medicinal and spice plants provide an example of how the cultivation of alternative crops in recent years can be successfully expanded. Insecure prices, widely fluctuating yields, as yet crude methods of cultivation in particular in organic farming and high drying costs often oppose the further expansion of domestic production. Nevertheless the cultivation of medicinal and spice plants represents an interesting alternative in particular for small and medium sized farms. This is particularly the case when contractual regulations offer the grower an assured turnover at guaranteed prices. In general a growing interest in pharmaceutical and cosmetic products based on active plant substances can be ascertained. The cultivation of medicinal and spice plants is also a reaction to the trend towards intensifying the use of regionally produced natural materials for medicinal purposes or in the kitchen.

Intensive research and development work has been carried out on dye plants in the last 10–15 years which also involved the manufacturing companies. This work has not yet however led to a significant increase in the cultivation of dye

plants in Germany. The targeted dye plants are above all important for consumers who exhibit allergic reactions to synthetic dyes.

The growing of *fuel plants* is sponsored with an acreage payment of 45 Euros and additionally on conversion into electricity in accordance with the Electricity Feed Law (EEG). They are thus able to make a contribution to the safeguarding of agricultural income in the long-term. The fuel plants targeted are distinguishable by their rapid and mass growth. Permanent crops such as miscanthus and short rotational plantations have not yet gone beyond the experimental stage in Germany.

Sudan grass and *sweet sorghum* are gaining in importance as fuel plants in Germany (especially in Bavaria) and Austria, particularly for their use in biogas plants. The distinctly lower risk of nutrient eluviation and soil erosion during the energetic use is positively evaluated above all when compared to maize. Lower water requirements and good fermentation characteristics are further advantages.

Miscanthus has comparatively favourable fuel characteristics. Its low water and nutrient consumption cause a very efficient use of resources. The moderate expenditure for crop protection as well as the long resting of the soil has positive effects on the fauna and the soil fertility. Miscanthus in Germany has to date, in spite of the favourable prerequisites and contrary to very high original expectations, found hardly any acceptance as a energy plant. Thereby a predominant role is played by difficulties in establishing a standing crop, widespread prejudices against permanent crops and process engineering risks due to the winter harvest.

Short rotational plantations with *poplars* and *willow* provide high biomass yields. Poplars in particular can be grown with comparatively little application of fertiliser. The way things stand the use of pesticides can be dispensed with as well. An increase in disease and pests is however to be expected as cultivation expands. Harvesting short rotational plantations requires a special harvesting method. Energy wood plantations thereby require a fundamental conversion of production.

ALTERNATIVE METHODS OF CULTIVATION

As alternative methods of cultivation this report discusses procedures which counteract the ongoing decoupling of crop production from natural locational factors and thereby tend to make a contribution to the conservation or the



recovery of the multifunctionality of agriculture. They should serve to spare resources and conserve biodiversity. A clear boundary line between conventional methods of cultivation or those based on the »rules of good technical practice« in crop farming and alternative methods of cultivation cannot be drawn. The report deals with mixed cultivation, special row crops and mulch procedures. Methods of cultivation such as ploughless soil tillage, which in the meantime are established as standard practice, are not discussed.

Mixed cultivation

The term mixed cultivation designates the *simultaneous cultivation of several species* (and several varieties of similar species) *on the same field* with varying contact between the mixing partners. The joint cultivation of different plant species corresponds significantly more to the variety of natural vegetation cover than monoculture. Mixed cultivation represents a traditional method of cultivation, whose advantages above all lie in yield stability and the sparing of resources. The positive effects of mixed cultivation are determined by the competitive behaviour of the mixing partners. The clearer the reciprocal stimulation, the greater the advantages are as well.

The following effects are named as *positive effects* of mixed cultivation:

- > a reduction of the farming risk, when the mixing partners differ significantly in their tolerance to stress and susceptibility to disease;
- > use of supplementary effects (e.g. covering crops);
- > an increase in the use of solar radiation through the enlarged leaf area index;
- > the promotion of weed suppression through stronger shadowing of the soil surface;
- > an improvement in the exploitation of the site through differences in the conformation of the stand and in the root system of the mixing partner;
- > an increase in the final output per unit of area where there is a low yield for the individual mixing partners;
- > an increase in the stability of yield on marginal sites;
- > a reduction in the use of pesticides.

Mixed cultivation also carries a number of *risks* however:

- > higher technical expenditure for sowing and harvesting;
- > a loss of efficiency in particular when applying nitrogenous fertilisers due to the different requirements of the mixing partners with regard to the timing and amount to be administered;

- > complications when combating diseases, pests and weeds due to the different sensitivity of the mixing partners towards the agents applied;
- > an increase in the input of working hours per unit of area;
- > an increase of input after harvesting processes for the cleaning, separating and drying of the harvested crops.

The improvements in cultivation methods and the high efficiency of production factors (fertilisers, pesticides) have severely reduced the advantages of mixed cultivation and thus to a large extent *ousted mixed cultivation* from conventional agriculture in favour of monoculture. In spite of that, scientific tests and practical experience from previous decades support the conclusion that the mixed cultivation of cereals could contribute to the greater ecologisation of conventional agricultural production. The contribution exists in particular through the possibility of reducing the use of pesticides.

Mixed cultivation constitutes a method of production in *organic farming* helping to reduce fungal pathogens and animal pests and regulate undesirable wild plants (weeds). However the statements made on crop protection are as yet lacking in scientific proof. Special importance is awarded to the mixed cultivation on marginal sites of individual cereals. It contributes significantly through the expansion of the diversity of species to the stabilisation of crop production. New production alternatives also arise with mixed cultivation, if e.g. foodstuff or feedstuff production is combined with the production of renewable primary products. The mixed cultivation of legumes or grain with gold of pleasure is an example of this. This mode of production of renewable primary products has the advantage that it can also take place on low-yield sites without interfering with the humus balance.

Special row crops

The concept of the »*wide row*« system developed in organic farming is an example of a special row crop. The limited N availability commonly leads to low crude protein content and thereby to an unsatisfactory baking quality in wheat. A widening of the row width of up to 50 cm, a reduction in the sowing intensity and a transition to weed regulation with a mechanical hoe are practised as solutions to the problem.

Row crop configurations such as »row intercropping«, »strip intercropping« and »relay planting« play an important role particularly under the climatic conditions in developing countries and serve as protection against erosion and a better use of nutrients. At the same time they increase agricultural biodiversity.



For work programme reasons alone a transfer to German conditions would be difficult. Systems of »relay planting« such as undersowing or onsowing are partially used in Germany to provide protection against erosion and nutrient absorption.

»Alley cropping« refers to a method of cultivation, in which the combination of agricultural crops with perennial plants is represented as an agroforest system. Hedges have existed for centuries as windbreaks on sites in Germany particularly exposed to the wind. Apart from protection against erosion, windbreaks encourage biodiversity and create new habitats for flora and fauna. The plants used are often fruit or nut species (sloe, sea buckthorn, hazelnut and others), whose fruit can be used for human nutrition. Within pasture utilisation systems the plant species cultivated can also be used as forage or serve as shade trees. New application possibilities were successfully tried out as part of the recultivation of »landscapes after mining« in Lusatia.

Mulch procedures

Mulch procedures comprise of the complete or partial *covering of the soil surface with organic waste*. The primary aim of mulch procedures is to reduce the danger through erosion of agricultural areas. In addition further effects are achieved with regard to retaining water reserves in the soil, the reduction of weed density and with regard to the regulation of soil temperature and activation of soil life. Mulching is normally related to procedures involving reduced, non-turning soil cultivation and *direct sowing*. Working crop residues in the surface or leaving them on the soil have already proven themselves in many sites in Germany, as well through the availability of effective herbicides resulting in an improved control of weeds in these systems. Advantages in the annual work programme and the reduction of diesel fuel costs are classified as the main advantages. Mulch sowing procedures can be used with almost all agricultural crops today.

POSSIBILITIES FOR ACTION

Several possibilities for action are developed in the report based on the preceding analyses. These proceed on the assumption that a more intensive use of alternative crop plants and methods of cultivation are to be striven for, in order to make a contribution to a higher level of agricultural biodiversity and to exploit new sales opportunities for agriculture.

Breeding

The low breeding activities and the thus induced wild plant characteristics of the alternative crop plants discussed have been brought out as a central problem area. From this it follows that research on plant breeding and breeding of alternative crop plants are accorded *central importance*.

Breeding studies on alternative crop plants, such as the study at Giessen University on gold of pleasure, is the exception. More intensive breeding of alternative crop plants would be desirable. The breeding of alternative crop plants is a medium to long term endeavour requiring considerable investment, with no returns promised until after the establishment of efficient varieties or markedly improved varieties and with only a limited market expected for the time being. Therefore this has to be a public research endeavour, and it requires financial support for private breeders.

The breeding targets for alternative crop plants from the crop groups concerned could be for instance:

- > breeding for stability of yield with gold of pleasure,
- > change of the fatty acid composition of gold of pleasure,
- > increase of the fibre content of the fibre nettle,
- > screening for bigger seeds for amaranth, quinoa and gold of pleasure,
- > breeding of varieties of amaranth and quinoa with a lower shattering tendency.

Breeding alternative crop plants can only make progress when *coordinated activities* are undertaken by the plant breeding institutes at Universities, the Federal Centre for Breeding Research on Cultivated Plants (BAZ), the Institute of Plant Genetics and Crop Plant Research (IPK Gatersleben), the corresponding federal state institutions for plant breeding and private breeding companies.

Integrated research

Research activities on alternative crop plants and methods of cultivation have not rated highly to date. A need for research is perceived in particular for the systematisation of the available state of knowledge, for the cultivation field trials of alternative crop plants at different sites and for the further development of cultivation techniques as well as to review and further develop methods of cultivation. Insights which are gained under concrete cultivation conditions by practitioners or by means of »on-farm research« should be collected and evaluated.



Technical solutions, which frequently originated individually at establishment level, should be taken up.

Integrated projects on alternative methods of cultivation should concentrate on *mixed cultivation* among other things and integrate investigations of the biological essentials of mixed stock, for the improvement of stock management, for the optimisation of the harvest, for operating efficiency and for the ecological consequences. Research, field trials and demonstration projects should be combined. Questions relating to mixed cultivation both in conventional agriculture as well as in organic farming should be dealt with.

There are examples of successful integrated projects with alternative crop plants across the whole production chain, such as for instance the projects of the Agency of Renewable Resources (FNR) on dye plants and medicinal plants. Comparable activities for their utilisation as foodstuffs are hitherto lacking. In *integrated projects on alternative crop plants for the foodstuffs sector* questions on breeding, cultivation, processing, marketing and the use of the foodstuffs should be dealt with collectively. This would involve protagonists from breeding, agriculture, processing and food manufacturing.

Production systems from industrial countries often present a model for developing countries. The transfer of knowledge and technology generally tends to be from the industrial to the developing countries. With regard to sustainability, regionally specific approaches to cultivation methods and the selection of crop plants in Germany could offer a different model to modern high-technologies. *Special row crops* could actually prove to be an example of how things may conversely be learned from developing countries. First of all a potential assessment should be carried out, in order to examine the possibilities of a transfer to German conditions.

RESEARCH ON AND PROMOTION OF RENEWABLE PRIMARY PRODUCTS

The promotion of research, development and demonstration projects in the renewable primary products sector has played an important role in Germany over a number of years. In this context projects on alternative crop plants have also been repeatedly carried out. These activities should be continued, in particular those relating to the material uses of alternative crop plants. In the course of this there should be a link to the current discussion on the material utilisation of renewable primary products between the Federal Ministry of Food, Agriculture and Consumer Protection (BMELV) and the chemical industry.

Conservation and sustainable use of plant genetic resources

The »National Work Programme on the Plant Genetic Resources of Agricultural and Horticultural Crops« is the foundation for the long-term conservation and use, research and development of genetic resources in the field of agricultural and horticultural crop plants as well as wild plants in Germany. This programme was developed under the control of the BMELV by a working group made up of representatives of the Federal and regional governments, universities, relevant research institutes and associations and adopted by the Conference of Agriculture Ministers in Bad Nauheim in March 2002.

The goal is to conserve plant genetic resources through an *integrative approach* using in-situ-conservation, on-farm management and ex-situ conservation. Concerning use there are main two approaches:

- > the use of plant genetic resources for modern varieties, in particular the main crop species,
- > on-farm management of old crop species and land varieties.

In the first approach the diversity of plant genetic resources is to be made utilisable *for modern varieties – in particular the main crop species* – by characterising, evaluating, documenting and tapping breeding potential. Examples of this are the utilisation of wild species and land varieties as an important source of resistance genes. Thus the mildew-resistant gene Pm5, which is present in many current wheat varieties, can be traced back to an Asian emmer (*Triticum dicoccon*). Barley varieties, which are resistant to the barley yellow dwarf virus, were attained by crossing with land varieties from East Asia.

The second approach is the Network of Cultivated Plant Initiatives KERN which is primarily active in the field of horticultural cultivated crop species. There are additionally individual initiatives on the on-farm management of old agricultural crop species and varieties, particularly in organic farming. The primary objective of these activities is to conserve the traditional plant genetic resources in cultivation and at the same time to use them commercially.

A third pillar which could be extended would be to utilise the *crop species diversity as diversification potential for land cultivation*. This approach is also addressed in the National Work Programme. It is primarily concerned with the emphasis on and implementation of the respective measures, such as *the promotion of longer-term breeding projects* thus far neglected by breeders. With the further development of the cultivation of alternative crop plants to efficient va-

rieties, which in turn permit a greater crop species diversity in crop production, a contribution to higher agricultural biodiversity could be made.

The BMELV guidelines for the promotion of model and demonstration projects in the area of conservation and the innovative sustainable use of biological diversity provides among other things for the »development of innovative products and procedures on the basis of genetic resources for sustainable use according to economic, social and ecological basic principles «. This could be one place where projects for the use of alternative crop plants could be promoted.

AGRARIAN ECOLOGICAL POLICY FRAMEWORK

The European Union's Common Agricultural Policy (CAP) was reformed once again with the Decision reached by the Luxembourg Council on 26th June 2003. The European Commission had presented its proposals for a further reform of the CAP in January 2003. The proposals were in essence for a *decoupling* of direct payments from production, a further cutting of market and price support as well as a strengthening of policy for rural areas. The Council of the European Union followed the Commission's proposals for the most part with its Decisions on the Reform of Agricultural Policy from June 2003. The Decisions were less far-reaching than the Proposals however, and numerous options for the arrangement of the premium system were left open for the Member States. The translation into German Law took place in 2004; the reform came into force effectively in 2005. These new agricultural policy conditions also affect the opportunities for alternative crop plants and methods of cultivation.

Central to the reform decisions is the decoupling of the greater part of what had hitherto been direct payments from the agricultural production granted as an acreage or animal premium. The direct payments are thus transferred from the agricultural production to the farmer. This will thereby increase the farmer's freedom to decide what to produce. Farmers will have the option in future of switching over to more profitable agricultural production, without losing their right to claim premiums. This freedom to decide is in perspective also advantageous for alternative crop plants (and methods of cultivation) as their selection no longer has a bearing on premium claims. This will change little in the short term due to the lack of competitiveness.

A prerequisite for the receipt of the all decoupled and coupled direct payments is compliance with specific management requirements (cross-compliance). These commitments comprise basic demands for farm management, requirements to

keep all farmland in good agricultural and ecological condition as well as regulations on the maintenance of permanent grassland. If these provisions are not respected payments will either be reduced or in cases of deliberate infringements in extreme cases withheld in full. In addition to pertinent EU Regulations, the cross-compliance regulations encompass the national minimum requirements for the maintenance of farmland and for soil protection. Implications for the opportunities for alternative crop plants and methods of cultivation are not expected.

Through *obligatory modulation* a predetermined percentage of the direct payments will be withheld in every Member State from 2005 on. The monies thus released increase the means available to the Member States for rural development measures. Besides this the spectrum of measures for the *promotion of rural development* has been expanded. The Federal government participates within the framework of the Joint Task for the »Improvement of Agrarian Structures and Coastal Protection« (GAK) using principles for the *Promotion of land cultivation suited to the market and habitat*, among other things through the promotion of ecological and *environmentally-friendly methods of cultivation in agriculture*. Within the scope of environmentally-friendly methods of cultivation in agriculture the cultivation of varied crop species as well as mulch or direct sowing procedures are already subsidised today. There would be an opportunity here to add the mixed cultivation of cereals as a new subsidisable measure. This would be an acknowledgement of the positive influence of voluntary agrarian environmental measures on agricultural biodiversity. On the level of the Federal States the possibility exists of integrating additional regionally specific measures over and above the agrarian environmental programmes there.

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