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Tailor-made Biotechnologies: Between bio-power and sub-politics

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Abstract

The development of a new food system and the development of agro-industrial biotechnology influence each other mutually. Biotechnology, in this article analyzed as a social-technical ensemble, reflects the surpassing of industrial by post-industrial society. Its products - seeds, enzymes and biocatalysts - help to create new social relations in global food systems, in which the traditional borders between political, economic and social-cultural aspects are blurred. It is argued here that these new biotechnology products are 'politicizing products' transforming the global food system, in which a new bio-power system emerges. The hegemonic position of the bio-power system is maintained through three separation processes. Yet various initiatives are challenging the bio-power system, not by rejecting, but by transforming biotechnology, and by connecting what is separated in the bio-power system.

I. Biotechnology as a social-technical ensemble

The development and application of biotechnology [1] does not take place in a historical vacuum but is shaping and shaped by the social context in which it appears. An important social and political change to which the development of biotechnology has been related is the establishment of the agro-industrial production chain. This change comprised a spatial transformation of production, i.e. from geographically concentrated units towards spatially dispersed production systems (Belforte et al., 1976), and a political transformation, e.g. the emergence of new social movements (Negri, 1979). The spatial and political transformations also took place in the agricultural sector, which became increasingly integrated in an international organization of food chains split up into four main sections:

1 Biotechnology has been defined as 'the application of scientific and engineering principles to the processing of materials by biological agents to provide goods and services' (Bull et al., 1982, p.21).

1. Use of inputs such as seed, pesticides and agricultural machinery,
2. Agricultural production,
3. Industrial processing of agricultural products into food stuffs,
4. International retailing of these manufactured products to consumers.

The social conflict regarding new social relations in (post-)Fordist production processes forms the context out of which biotechnological developments took shape (Ruivenkamp, 1989). Biotechnology strengthened the transformation of agriculture from an independent sector towards a segment of an agro-industrial production chain. On the other hand biotechnology has been strongly interwoven with two long-running historical processes of the industrial transformation of agriculture, summarized by the terms *appropriation* and *substitution* (Goodman, Sorj & Wilkinson, 1987, cited by Pistorius & Van Wijk, 1999, p.17).

Appropriation refers to the gradual take-over (appropriation) of the controllable biological activities from farming practices by external institutions, especially industry. A concrete example is the breeding of new cultivars and the maintenance and propagation of basic seeds that was originally done by farmers but is now increasingly taken over by public research institutions and private companies.

Substitution refers to the historical development by which the agrarian origin of food sources is gradually being replaced by products of industrial-biochemical methodology. This development undermines the direct relation between agriculture and food production. An example of this development is the replacement of beet and cane sugar by maize fructose syrup and synthetic sweeteners such as aspartame (Ruivenkamp, 1986).

The reorganization of the international food system has further been affected through the development and supply of new *knowledge-intensive products,* such as artificial fertilizers, which marginalized farmers' practices of crop rotations to manage soil fertility (Jongerden & Ruivenkamp, 1996) and by developing hybrid maize varieties which left the maize producer completely out of the loop in the creation of new maize varieties (Kloppenburg, 1988). Indeed, the industrialization of agriculture has proceeded through this dual process: the appropriation and substitution of farmers' activities enables external agencies (industries) to become key players in the reorganization process of agricultural production, which has been relocated in the space of the agro-industrial production chain. Subsequently, the development and use of new

artifacts (such as hybrid varieties, fertilizers, pesticides, etc.) enables the companies to re-link the (new) farmers' activities to their own interests.

Biotechnological research has been focusing on these knowledge-intensive products, such as seeds for sowing, basic chemical ingredients, enzymes and microbiological produced fatty- and amino-acids, and has consequently strengthened and even *transformed* the reorganization of the international food system. The historical process of an industrial appropriation of farming activities is gradually changing into the *control at a distance* of farming activities. Through the development of tissue culture, cell fusion and r-DNA techniques, the life science companies can *quantitatively increase* their possibilities to intervene more radically and efficiently in the genetic structure of plants and determine where, when and how a crop should be sown, harvested and processed. It is precisely through the supply of these new seeds with specific properties that the life-science companies can program 'from a distance' the way crops are cultivated - with or without herbicides, for example.

Biotechnology also makes it possible to intervene more efficiently in the preserving and processing of the agricultural produce into food products. The development of enzymes and other biocatalysts enables food manufacturing companies to extract and produce food components form a broad spectrum of different agricultural and synthetic resources. The *interchangeability* of products is the other main characteristic of the global organization of food production.

The development towards a new food system has further been strengthened by the possibility of patenting exactly those products which contribute to the reorganization of the social relations in global food chains. The patenting of these 'politicizing' products (Ruivenkamp, 1989) can no longer be interpreted as an economic recognition of an individual innovation, but should rather be seen as a political action to give companies an exclusive right to introduce new social relations in global food systems.

Through the quantitative expansion of producing (and patenting) these knowledge-intensive products a *qualitative new food system* is emerging, in which the historical processes of appropriation and substitution are being transformed into *remote control* and *interchangeability* and in which the traditional distinctions between the political, economic and cultural are increasingly blurred. Furthermore, a new system of bio-power is emerging.

II. The emergence of the bio-power system

Biotechnology as a specific ensemble of social and technical dimensions does not only reflect relations of power but also contributes to the establishment of new power relations within a reorganizing food system. An important characteristic of this new bio-power system is that the *political system is increasingly shifted into the social organization of production.* Increasingly, it is the researchers of life science companies and not the policy-makers of ministries who are the real political actors, able to regulate the social organization of the agricultural production process *from a distance* through the supply of their new seeds containing specific information.

A second characteristic of the bio-power system is that some products, such as seeds, can no longer be considered as being just material goods. They create primarily new social relations. These particular products do contain *this immaterial (politicizing) component.* The blurring of political and economic activities does not only change the domain of politics but also the domain of economics. Therefore, the selling of seeds (or of a biotech company) can no longer be considered as just being an economic activity, because the immaterial component is also bought, which implies that through the acquisition of seeds (seed-production company), one has become a political actor able to program the agricultural production from a distance.

Thirdly, the power balance between different actors of the agro-industrial production chain is changing. The increased externalization of agricultural research and the distribution of the knowledge-intensive inputs to farmers imply a modification in the original knowledge base of farming practices, in which farmers' knowledge about their (traditional) farming practices is *(being) devalued* and their craftsmanship in e.g. the reproduction of crops is no longer indispensable for good farming (Van der Ploeg, 1991). The spread of the knowledge-intensive inputs '*produces ignorance*' at farmer level and creates a new market for information which is supplied by a new group of actors (the extension officers), while at the same time farmers may become increasingly 'workers in the open air' remotely controlled by life-science companies.

The reorganization of social relations is further extended insofar as the emerging bio-power system is also challenging the *social-cultural sovereignty of a* region, as expressed by location-specific production methods. Because the life science industries can nowadays apply patented plant breeding techniques (e.g. the *Agrobacterium* transformation method) for making different varieties (such as herbicide-resistant, disease-resistant, pest-resistant, nitrogen-fixating, and vitamin and mineral enriched crops), attuned for different

agricultural production systems, the location-specific production methods no longer illustrate a certain regional sovereignty. On the contrary, the location specific production methods may become a crucial factor in the strategy of companies to maximize the returns on investment in the patented techniques by supplying the regions with their differentiated products (for example herbicide-resistant crops in the South and high yielding organic crops in the North), attuned to the different characteristics and production methods in the region. The implication of this new interrelationship between basic plant breeding techniques, patented by a small group of companies and applicable to different crops for different regions, is that the *reproduction* of the bio-power system may no longer be primarily based on the global dissemination of the same (uniform) seeds for as many regions as possible, but on a *segmentation* of global food production in regionally differentiated production systems (e.g. GMO and GMO-free productions), using different seeds but all related to the same patented techniques.

Similar changes have also occurred in the relations between farmers and food processing companies. The quantitative expansion in obtaining food components from various agricultural and biochemical resources through the development of enzymes and biocatalysts has led to a qualitative shift in food production. Food processing companies have become able to liberate themselves from the linear and regional integration of agriculture and food processing, in which a specific agricultural product was processed into a specific end-product, and are increasingly able to aggregate the food components such as proteins, fats and carbohydrates, minerals and vitamins from various agricultural and biochemical resources. The companies, developing these catalysts, are acquiring a *political identity.* They have at their disposal the scientific and technical capacities to make a growing number of farm crops and industrially manufactured food components mutually interchangeable. They have in their hands the mechanisms to divide and control the producers of these basic nutrients. Increasingly they can decide which and how farmers, workers and microorganisms in the different sectors in different countries can be played off against each other. Within this new production system of food components, assembled from a broad range of agricultural and biochemical resources, the original differences between various crops and their producers are leveled out. This has also led to a *political involution of those product-oriented organizations* (farmers' organizations and unions) that still aim to aggregate their members around these (vanishing) product-oriented sectors.

Finally, the already indicated modification of the *social-cultural sovereignty of the region* is also strengthened by the changes in the third phase of the agro-industrial production chain. Each region (*locality*) may be able to aggregate its own desired combinations of food components from various global/local flows of food components to an ever greater extent. An apparently increased autonomy of regional food supply at local level may arise, dependent, however, on the use of globally developed biocatalysts. Besides, international competition between the food components aggregating companies may increasingly be based on using the advantages of the specific regionally organized forms of producing, converting and assembling food components. These regionally different forms may effectively be transformed into *interchangeable production units* (of the food components assembling companies). This development will change the traditional meaning of regional food sovereignty, which can no longer be exclusively defined at production level. On the contrary, the relation to the globally developed biocatalysts will also have to be taken in consideration. This implies that the *identity of locality* can no longer be exclusively defined in geographical terms, in relation to the local ways of producing food, but will increasingly be formed in relation to these new global/local flows of enzymes, biocatalyst and other biotech products. The final section of this article will therefore describe how communities aim to re-construct their local identities by re-appropriating and modifying various biotechnological developments. First, however, we will consider how (through which social processes) this emerging bio-power system is strengthened, and where openings for an increased democratization of science and technology development can be found.

III. Hegemonic Biotechnology

The concept of hegemony refers to domination which is so strongly embedded in social life that it is not queried anymore; not even by those subject to it. It concerns a domination that has the force of culture behind it (Feenberg, 1999). One can speak of hegemonic biotechnology when the bio-power system is based on assumptions which seem so natural and obvious that these assumptions lie below the threshold of conscious awareness. It is also important to emphasize that the concept of hegemony refers to a *qualitative interpretation of social relations.* Michael Hardt and Antonio Negri describe it as follows:

> *'When we claim that immaterial labor is tending toward the hegemonic position we are not saying that most of the workers in the world today are producing primarily immaterial goods. On the contrary, agricultural labor remains, as it has for centuries, dominant in quantitative terms, and industrial labor has not declined in terms of numbers globally. Immaterial labor constitutes a minority of global labor, and it is concentrated in some of the dominant regions of the globe. Our claim, rather, is that immaterial labor has become hegemonic in qualitative terms and has imposed a tendency on other forms of labor and society itself. Immaterial labor, in other words, is today in the same position that industrial labor was 150 years ago, when it accounted for a small part of the world's labor but nonetheless exerted hegemony over all other forms of production. Just as in that phase all forms of labor and society had to industrialize, today labor and society have to informationalize, become intelligent, become communicative, and become affective' (Hardt & Negri, 2004, p.109).*

From the overview of the development of commercial biotech/GM crops given by the International Service for the Acquisition of Agri-Biotech Applications (ISAAA) one can notice an impressive growth of transgenetic crops,[2] but which represents, however, only 5% of the total global cultivable crop land area (James, 2004, p.vi). Still the new seeds, enzymes and biocatalysts as politicizing products exert a reorganization of global food production.[3]

This hegemonic position of the agro-industrial biotech development is based on its embedment in and strengthening of three historical separation processes in the social organization of the agro-industrial production chain. Furthermore, the hegemonic position of the agro-industrial biotechnology is not challenged but rather confirmed by the actual pro-anti biotech debate. These two factors strengthening the emergent bio-power system - the pro-anti biotech debate and its relationship to the historical separation processes - will be now be considered, followed by the description of some intrinsic conflicts which may challenge the dominance of the agro-industrial biotech development.

2 The global area of biotech increased more than 47 fold, from 1.7 million hectares in 1996 to 81.0 hectares in 2004. Approximately 8.25 million farmers in 17 countries were cultivating biotech crops in 2004 (James, 2004, p.iii). However this impressive growth is limited to only four crops (soybean, corn, cotton and canola) in which only a very limited number of plant traits has been changed (herbicide and Bacillus Thuriengiensis (Bt) tolerance (James, 2004, p.20)

3 As in the past industrial production represented only a small part of all production processes, nowadays the biotech products, being present at only 5 % of global cultivable land area, exerts also its influence over other forms of production.

III.1 The ideology of the pro-anti biotech debate

Although I cannot present a complete analysis of the actual pro-anti debate in this article, attention will be paid to some of its core elements to unfold the ideological function of the debate, which is evolving at international level. It will be shown that some basic assumptions on which the hegemonic position of agro-industrial biotechnology is based are strengthened and repeated in that debate.

First, the pro-anti biotech debate is characterized by its focus on and identification of agro-industrial biotechnology with its most spectacular form, the gentechnology. All other kinds of traditional, modern and hybrid forms of biotechnologies are neglected, confirming the hegemonic position of bio=gentechnology.

Second, the debate is dominated by a specific group of participants which I have called *the splitters* (Ruivenkamp, 1997, p.281). These persons separate biotechnology from its social context and consider biotechnology as just a group of techniques. Whenever they discuss the social dimensions of biotechnologies they refer to the consequences of the technologies for society. The splitters are divided in two subgroups, the optimistic and the pessimistic, those who think that biotechnology might solve all problems and those who emphasize its negative impacts. However, both the supporters and opponents of the agro-industrial biotechnological development *start from the same basic assumption* that it is possible to discuss the impacts of a specific factor (biotechnology) on a generalized and abstract institution or process (society).

By discussing the positive or negative impacts of biotechnologies the splitters are not questioning why the products are developed as they are. And if they do ask this, than they emphasize that biotechnological developments are the results of free choices of the individual laboratory researchers. The splitters refer to the linear model of scientific development. Science is developed in the laboratory and provides rules that are used in technology which is applied in society in which changes are thereby created. Because of their thinking in terms of cause and effect, the splitters are very active in the social debate. They ask for a social evaluation of the influences of biotechnology on society, agree upon a case-by-case evaluation and are inclined to differentiate between good and bad biotechnologies. Furthermore, the splitters are interested in the most advanced examples of the new techniques, focusing on the most spectacular examples of biotechnologies on which to base their judgments and

thus confirming that biotechnology needs to be associated with gentechnology (see the first point, above).

Third, the pro-anti debate is characterized by extrapolating the developments in the biotech area for the whole cultivable crop land area. Although the biotech area actually represents only 5% of global cultivable crop land, as stated above, still very *general claims* are formulated on basis of what happens within this limited area. This is done because it is assumed that the biotech developments are determinant for what happens in the rest of the world (the cause and effect idea) and because the modern biotech development is perceived as an example that will be copied by and integrated into all other production forms (the linear idea of development).

Fourth, the pro-anti biotech debate may also become *a complex in itself with* its own interests. Just like the bivalent military complex which was constructed during the Cold War in the capitalist and socialist blocs, there is now emerging a *debater complex.* Not only do new industries appear in relation to the pro-anti debate, such as industries which produce markers for guaranteeing GMO-free food chains, but also this complex regulates the space in which contrasting ideas can appear. Just as pacifist ideas could not get a hold in the military complex of the capitalist and socialist blocs during the Cold War, nowadays the pro-anti debate gives no space for ideas which deny their basic assumptions. These other ideas expressed by other groups - such as the weavers and the redesigners as I called them (Ruivenkamp, 1997, pp.281-282) - have to find other ways of expressing their ideas, developing their own communication channels alongside but separated from those of the dominant pro-anti debate.

In other words: the intensive bipolar debate between the supporters and opponents of the agro-industrial gentechnological development fulfills an ideological function because it reproduces a certain kind of vagueness (about other forms of production), it strengthens some basic assumptions (see point 2), it represents a virtual image of reality (see point 3), it creates own interests (see point 4) and masks possibilities for change. The ideology is presented as if one can only choose between accepting agro-industrial biotechnological developments without changing them or else protecting oneself by rejecting biotechnological developments completely. Both positions represent *a lack of imagination* about the possibilities for *changing* the biotechnological developments.

More promising seem to be the concrete efforts of civil society organizations and research institutions that go beyond this frustrating pro-anti debate

and try to develop a 'third approach', a re-establishment of *new co-creative relations* between biotechnological and endogenous developments to reach those people who have been bypassed by the industrialization of agriculture and Green Revolution. The main concern of these multi-stakeholder platforms is to find out if and how the social/technical potential of modern and traditional biotechnologies can be socially negotiated, manipulated and related to issues of food sovereignty, equity and sustainability. However, these efforts to change biotechnology from an exogenous instrument into a social catalyst for location-specific developments (Ruivenkamp, 2001) are constrained by the emerging bio-power system. Therefore, it is also necessary to understand through which social processes the hegemonic position of the actual bio-power system is maintained and even reproduced by those who are subject to it, and where openings for an increased democratization of the biotech development can be found.

III.2. The embedment of agro-industrial biotechnology in three separation processes

The new bio-power system is maintained not only through an ideological pro-anti debate in which specific assumptions are shared and taken for granted, but also, and more importantly, through the relation of agro-industrial biotechnology to three historical processes of separation: the separation of agriculture from its ecological environment; the separation of agriculture and food production; and the separation of the agricultural products from its intrinsic food quality. By strengthening and modifying these social processes the agro-industrial biotechnology creates a new global food system in which immaterial labor acquires a hegemonic position. The first social process through which the hegemonic position of biotech crops is being established is the uncoupling of agriculture from its ecological environment.

The separation of agriculture from its environment

The genetic structure of a plant is primarily formed during evolution by the interaction of the plant with its natural environment. Natural selection has enabled plants themselves to internalize the requirements for good growth from their environment into their genetic program. For this reason some plants grow well in a cool climate and others in a warm climate. Attempts have been made by traditional improvements and cross-breeding techniques to shift the limits of these narrow relationships between plant growth and their natural

surroundings. This was done during the Green Revolution when attempts were made to bring other information into the genetic program, especially for the purpose of higher yields.

So, there has been dualistic development. Improved plant breeding techniques have on the one hand 'freed' the agricultural varieties of the limiting characteristics of their natural surroundings but on the other hand made the plants dependent on externalized agricultural research for incorporating specific scientific information into the seeds. It is clear that this tendential transformation of uncoupling seed reproduction from its surroundings and re-coupling it to scientific information, has not been completed, yet, and indeed forms a core element of a new social struggle through which food sovereignty in many areas will be determined. Indeed, a splitting contradiction is developing between development processes of 'informationalized' seeds with their specific politicizing content and many other (multiple) forms of seeds development in which other social objectives are incorporated. In the final paragraph we describe some efforts which challenge the hegemonic position of the informationalized seeds by applying hybrid forms of traditional and modern plant biotechnological developments.

The separation of agriculture and food production

Global food production has long been characterized by two contrasting developments: an increasing regional *uniformity of agricultural production* by cultivating crops like wheat, corn, rice, etc., and a regional diversity of techniques to conserve and process the agricultural produce in food products (Perelli et al., 1984). This diversity of regional methods of preserving and processing the agricultural produce (e.g. milk) has led to the presence of many regionally different forms of food products (e.g. various types of cheese). Through the up-scaling and 'scientification' of locally specific preservation techniques, as well as through the technical developments in different processing branches, a gradual quantitative shift in the processing techniques appeared: from a preservation and transformation of agricultural produce towards a splitting up and re-aggregation of food components, putting them together into a recognizable form of traditional or new food products to be sold to the consumers. One implication of this shift towards a food components aggregating production system, in which the food production is uncoupled from the agricultural produce, is that increasingly each region may be able to aggregate its own specific composition from various global/local flows of food components. An apparently increased autonomy of regional food supply

at local level may arise. However, this will be related to an increased dependency on the use of the globally developed biocatalysts; illustrating that immaterial labor, producing these knowledge intensive biocatalysts, also acquires a hegemonic position in the third phase of the food chain.

The separation of agricultural products from their intrinsic nutritional quality

The more farming products are regarded as a sum of biochemical food components (carbohydrates, proteins, and oils), the more the food industry can start procuring these components from industrial sectors too (as is evident from the biochemical production of amino-acids, fatty-aids and proteins). At the same time farming products can also be used for non-nutritional ends (for example, for ethanol production). The separation between agricultural and food products may be converted into a third separation process, namely the separation of agricultural products from their intrinsic nutritional quality. The segregation of farming products and their intrinsic quality as food products partly places the farming sector outside the social organization of the agro-industrial production chain. This implies that developments in the farming sector will no longer be determined through its relationship to the food industry, but by developments that take place significantly outside the food chain.

The concept of mutual interchangeability may acquire a new dimension, no longer limited to an interchangeability of agricultural, biochemical and synthetic routes to produce various food components, but rather extended to an *intensive competition between the different regional methods of producing products for different production chains.* The different ways in which production is socially organized becomes a core element in the international competition of regionally different social forms of production. Therefore, the products - through which the social relations and forms of cooperation at regional level are regulated - obtain a strategically important position, illustrating that immaterial labor will increasingly reinforce its hegemonic position.

In other words: the development of specific biotechnological products interwoven with the three separation processes leads to a specific (im)material content of these products. Through the incorporation of specific information, informationalized seeds and biocatalysts illustrate and reinforce the hegemonic position of the agro-industrial biotechnological development. The researchers developing these products acquire a political identity because they develop these immaterial (politicizing) products which create new social relations. It is important to emphasize, however, that the research activities of these immaterial laborers are not oriented to maintain the same production system; on the contrary the products in development are aimed to realize a continuous process of transformation, strengthening the hegemony of an emerging bio-power system. Therefore, the challenge is to investigate whether some specific contrasting developments may appear within the domain of the immaterial labor which may facilitate a transformation of the immaterial labor from a force that strengthens the hegemony of the bio-power system into a force that contributes to the realization of a democratic and sustainable application of biosciences and biotechnologies.

IV. Openings for the democratization of biotechnological developments

It is important to observe that the tendential transformation in the hegemony of material (industrial) into immaterial labor has also caused a new organizational form of production to appear: namely, the network (instead of the factory). Indeed, the international production of the politicizing products is characterized by an increasing concentration of production within a few companies in tandem with the presence of numerous fluid and hybrid networks of public/private, fundamental/applied research institutions through which the products are produced. So, the production of the informationalized seeds and enzymes takes place within a concentrated-decentralized system of production.

Moreover, the production of these information-intensive products requires a complete attachment of the person to his work. There is no longer a clean, well-defined threshold separating labor-time from non-labor time (Virno, 2004, p.103). For the immaterial laborer, his/her work is his/her life, and his/her life is his/her work. This personal involvement of immaterial laborers in their research activities implies that we can talk about an *expansion and intensification of working hours* for the producers of these politicizing products. However, there is not only an extension of labor-time for the immaterial laborer but also a *change in the relation between life- and labor-time* of the individual researcher, in the sense that the personal life-style of the laborer becomes the basis for his/her work. For the immaterial laborer all aspects of his/her individual human life become a potential to be used for the production of the immaterial products. The ability to learn, to adapt to different networks, to integrate different scientific disciplines, to be accustomed to mobility, to be affective and communicative; all these elements, which cannot be separated from the person, increasingly contribute to the weight of the individual contri-

bution - outside the workplace - to the production of the politicizing products (Virno, 2004, p.84). The practical consequence of this is that the personal life of the researcher and the hegemonic bio-power system are intimately interrelated.

Due to these peculiarities of the working conditions of the immaterial laborer, conflicting developments appear which may open new opportunities for challenging the hegemonic position of the emerging bio-power system. I will briefly consider two aspects: the re-coupling of ethics and technical potential, and the uncoupling of life- and labor-time from the bio-power system.

IV.1 Re-coupling ethics and technical potential

The complex organizational form of the production of informationalized seeds and biocatalysts in fluid, hybrid networks of private/public, fundamental/applied research institutions implies that individual researchers loose their grip on and insight into their own contribution to the immaterial (politicizing) content of the end-product. Although the end-products are characterized by their contributions to the creation of new social relations, the non-transparency of the complex production system causes researchers to be completely alienated from the social significance of their work. There is an *disjunction* from the organizational opportunities offered to the individual researcher to technically develop his/her work, while the same organizational form creates constraints on the individual researcher with regard to critical reflection on the social content of his/her work. The highly specialized type of work within fluid, international, hybrid networks implies that the technical potentials of the immaterial production are increasingly separated from a critical-reflective ethicality, although a broad ethical content is exactly the main characteristic of the products that are delivered by the immaterial laborers. The *uncoupling of ethics and technical potential*[4] will, however, become increasingly problematic, precisely because the broad ethical component is the core element of the products. Therefore, it is to be expected that researchers may increasingly demand *the re-establishment of a direct connection between production and ethicality* - not only in general terms but also, and especially, in all the different sub-segments of the complex networks of the immaterial products. By making concrete choices about the specific information to be incorporated in

4 The uncoupling of the technical potential and ethicality of production is reproduced by the formation of various *ad hoc* ethical committees dealing with broad philosophical questions about ethicality, ignoring the growing incorporation of ethicality in the specific forms of the immaterial products such as informationalized seeds and biocatalysts.

the immaterial products, individual researchers may contribute to a challenge to the hegemony of the bio-power system and be actively involved in the reshaping of other, new informationalized seeds and biocatalysts within other networks, illustrating that the immaterial laborer can also be related to democratic social changes and become protagonists for the development of what U. Beck (1994) has called 'sub-politics'.

IV.2. The uncoupling of life-and labor-time from the bio-power system

Instead of the 'compulsion of the conveyor belt' as the exemplary form of management for workers in the Ford-like development model, within the post-Fordist development model there is '*increasing self-punishment in complete freedom*' on the part of researchers producing the politicizing products without being able to find out which specific contribution they make (Ruivenkamp, 1989, p327; 2003b, p.35). Because the separation between work and life is increasingly blurred within the immaterial labor activities, the personal characteristics of the individual researcher becoming increasingly important for carrying out his/her immaterial work to create new social relations, researchers may become stimulated to liberate themselves from the connectivity of their activities with the hegemonic position of the bio-power system. New multiple forms of life and labor may arise through which the immaterial laborers aim to *disconnect their life from the bio-power system and to re-invent new areas of life and work* separated from the domain of the bio-power system. The emergence of these new liberated areas of life (and work) may be facilitated due to the crisis in traditional identity formation which has been significantly rendered void (Ruivenkamp, 2003a) and which may stimulate a *subjective reconstruction of identities, increasingly based on a rediscovery of locality or glocality.*

As described above, the hegemonic position of the emerging bio-power system may increasingly be based on a competition between various regional methods of aggregating food components from various resources, which are considered as interchangeable production units. Regulating the locally specific ways of producing and aggregating food components is the major task of the immaterial laborer. A contrasting development may appear between immaterial laborers working for an increased competition of regionally different production methods within the globally operating food companies and those immaterial laborers who aim to *reinvent locality* by realizing concrete changes in the (im)material aspects of the biotechnological developments, enabling multiple forms of location-specific developments.

An international network[5] has been formed to facilitate these efforts of re-inventing locality (or glocality), and it may be understood that a core element of this network is to challenge the separation processes on which the hegemonic position of the emerging bio-power system is becoming established. In the final section we will describe some concrete examples of how the efforts of the immaterial laborers to uncouple their labor and life time from the bio-power system and to reconnect ethicality in the technical potential of new biotechnological developments are coming together in concrete efforts towards tailoring biotechnological developments to endogenous developments.

V. Tailor-made biotechnologies from bio-power towards sub-politics

The idea of a different social embedment of biotechnological developments is often lacking. Therefore, the critique appears to take on the form of total denial of and protection against the agro-industrial biotechnological developments. Social organizations often follow this path of total dismissal because they are not able to imagine an alternative coalition of social and technical elements in biotechnology and genomics. Nevertheless various examples of multi-stakeholder platforms can already be found which follow a more constructive approach and aim to develop a balanced and dialectical approach towards integrating and indigenizing some (biotechnological) innovations, attuned to location-specific development trajectories.

The central question for such a balanced and dialectical approach is whether and how biotechnology as an exogenous instrument can be re-appropriated by local initiatives and become a catalyst for endogenous developments (Ruivenkamp, 2001). A core issue is whether these platforms are able to change the scientific information incorporated in the biotech products and challenge the three separation processes on which the hegemonic position of the bio-power system is based. Below we will describe how the partners of the international network on *Tailor-Made BioTechnologies for endogenous developments (TMBT)* are aiming to reconnect agriculture to environment as well as to local food consumption by redesigning traditional and modern biotechnologies.

5 This network is called Tailor-Made BioTechnologies for endogenous developments (TMBT) and is provisionally composed of organizations from Andhra Pradesh (India), Brazil, Cuba, Ghana, Kenya and the Netherlands.

Linking agriculture to environment

For the transformation of biotechnology, as an exogenous instrument into a catalyst for endogenous developments, it is crucial to create a new relationship between agriculture and its environment. It has been emphasized that the agro-industrial biotech approach is characterized by 'freeing' crops of their relationship with their surroundings on the one hand while on the other making them 'dependent' on externalized agricultural research. This dual process of uncoupling the (re)production of seeds from the constraints of the natural environment and re-coupling it to scientific information forms the basis on which the historical process of separating agriculture from its environment is strengthened by modern plant biotechnology developments.

Various research networks are challenging the embedment of traditional and modern forms of biotechnology within this uncoupling process by introducing other scientific information into the development of seeds which thus become oriented to 'other social changes'. For example, the National Research Centre for Sorghum (NRCS) of the Indian Council of Agricultural Research has developed *the dual purpose, early maturity sorghum variety* (CSV 15) in which different social issues have been directly taken into consideration, such as the possibility of changing the crop rotation system, in order to reduce the ecological problems of actual agricultural production systems, increase the income of marginalized farmer groups, etc. The CSV 15 is illustrative of *a social/technical ensemble approach, in which the variety itself catalyzes social changes other than just an uncoupling process.* Of course it is already a specific choice to focus the research on sorghum, which is one of the most important cereal crops for poor people and is grown for food, feed and industrial products. Besides, the development of a dual purpose variety has given the Indian farmers the opportunity to improve both the food and feed productivity. Still more innovative is the fact that it also concerns an early maturity crop. Instead of the 144 days of the recently released varieties, this new variety can be harvested after only 112-115 days (Rana et al., 2001, p.4), which has enabled the farmers to plant chickpea almost one month earlier as a rotation crop, minimizing the incidence of wilt in chickpea and reducing usage of chemicals. The short duration, dual purpose sorghum variety enables farmers to get an assured higher grain yield, to obtain a higher monetary return because of its dual (food/feed) purposes, and ensures a higher income because of the improved rotation with chickpea. Instead of harvesting one unsecured, long duration local sorghum variety, farmers can now cultivate and get income from two assured crops in a year. The CSV 15 sorghum variety shows that eth-

icality may be directly incorporated in the production of new informationalized seeds.

The above-mentioned example of the CSV 15 sorghum variety still confirms, however, the development of an increasing professionalization (and externalization) of seed development, which may imply a reducing accessibility to the developed seeds for the resource-poor. Indeed, many civil society organizations are struggling with the contradiction that the increased professionalization of seed production may lead to improved, high yielding varieties while at the same time the accessibility to these seeds may be reduced because the seed production has been disconnected from farmers' plots. So, there is a need to find new ways of *ensuring increased access to the professionally developed seeds.*

One option is to demystify the production of certified seeds by *encouraging and empowering farmers to re-enter into seed farming.* This has already led to many successful initiatives setting up participatory plant breeding programs. In Brazil, for example, plant breeders together with the inhabitants of the Sol da Manha settlement have developed and released one of the most successful maize varieties for environmental stresses areas (named the Sol da Manha variety). In Ghana, through a participatory plant breeding program, a lysine and tryptophan enriched maize variety (named Obtampa, which literally means 'good mother') has been developed and released to farmers since 1992 (Frempong & Essegbey, 2002). The example of the development of early mature, dual purpose and disease-resistant varieties of sorghum in India described above may also be cited in this context.

Another option is to develop a strategy for the *'de-commoditization of seed production',* giving farmers new opportunities to reproduce, for example, hybrids that do not lose their vigor. A concrete possibility is the application of apomixes, a technique that produces seeds without fertilization. Many wild plants are naturally apomixtic (for example the common dandelion, *Taraxacum sp.*, but not the domesticated crop species). The introduction of this trait to crop plants would allow them to produce seeds with identical genetic properties, fixing the plants' genetic make-up. Apomixes could be applied to obtain seeds from hybrid plants, while retaining the vigor of the first generation. Apomixes could provide small farmers with a tool for removing the hybrid's biological protection against propagation. It could thus undermine the profitability of the seed industry but also allows for an increased accessibility to seeds for many more of the world's farmers.

Research on *apomixes* in crops such as pearl millet, rice, maize and forage grasses has been carried out at various International Agricultural Research Centers (IARC's) (Van der Sande, Ruivenkamp, & Malo, 1996, p.185). However, concrete results are not yet known. Of course this research is a politicizing issue. On one hand companies may be interested to transform the hybrid's biological protection against propagation into a more general protection of the propagation of crops, either by applying patents on all the important characteristics of propagation, including the apomixes techniques, or by reinforcing the biological protection against propagation (e.g. terminator seeds). On the other hand, groups of scientists from various disciplines together with farmers' organizations may be interested to find concrete ways in which the propagation of crops can again come under the control of farmers and restore their role as innovators. Apomixes might be one *technological solution* to realize this objective. Another strategy, less spectacular but possibly more convincing, is the attempt to *socially change the production chain* of various reproduction techniques. Jasper Buijs (2002, p.48) describes the experiences of Indian farmers and NGO's in cutting shoots from tissue-cultured neem and teak tree clones. Instead of going through the whole tissue culture phase, they cut auxiliary shoots, taken from the tissue cultured teak and neem tree clones, put these shoots directly in vermiculite (a vermi-culture product) and let the shoots root directly. This medium is very cheap because it is made of regional waste products processed by worms and manufactured by the farmers themselves at village level (Buijs, 2002, p.34) and avoids the use of expensive agar-based media delivered by industry. This example illustrates the efforts of NGO's and farmers' organizations to *indigenize biotechnological developments* and to re-appropriate and modify parts of the innovation process. The consequence of this is that the newly developed method of the propagation of neem and teak trees is a hybrid between modern tissue culture technology and local vegetative propagation techniques (Buijs, 2002, p.48).

Many other examples exist in which modern and traditional techniques are mixed and *hybridized.* It is known, for instance, that the science-based tissue culture applications on local tree species in India such as amla, tamarind, custard apple and karaya, have been combined with people-based experiences of *applying the grafting technique* (Buijs 2002, p.80). Another example is the farmers' selection of local strains of *Bacillus Thuriengiensis* (Bt) and *Rhizobium* for their plant protective and growth stimulating characteristics. The Indian farmers also isolate and ferment the Bt material in field laboratories and distribute 'their' end- products in the form of pellets to other farmers

in the village. It is said that the selected strains have better results than the commercial Bt products delivered by industry because of the very strong regional orientation of the farmers' selection procedure. This case shows that through the integrated activities of selection, isolation, fermentation and distribution of locally specific Bt material, these farmers are re-grouping themselves and reconstructing their identities by refusing the externally produced knowledge intensive inputs and by combining traditional and modern knowledge systems, all of which makes them again innovators for a new production system.

Re-linking agricultural produce to food products

The hegemonic position of the bio-power system is also challenged by the efforts to develop location-specific biocatalysts, in which it is aimed to re-couple the agricultural produce to food production and consumption at local level. Some positive results have been achieved, although these initiatives have to deal with a growing pressure of international food safety regulations, creating constraints - for hygienic reasons - to the maintenance of traditional and location specific food preserving techniques. Nevertheless efforts are being made to keep the *local food production chain short,* by setting up fermentation units, either home-based or in small regional milling units. In Ghana, for example, maize - which is one of the country's most important staple foods - is conserved in the form of many different fermented foods, such as kenkey, banku, porridge and tuo zaafi, and serves as an important ingredient for children's food. Moreover, maize is brewed into alcoholic and non-alcoholic beverages (De Vries, 2002).

Considering the home-based fermentation units as a potential catalyst for household development, several initiatives have been launched to improve food sovereignty by *supporting households* to preserve and ferment the agricultural produce in local food products. In Kenya, for example, households have developed new techniques to make different end-products from cassava (cakes, snacks, soap, etc), while other households are making snacks to be eaten by their children during school time. Although these fermented products often suffer from hygienic shortcomings, a combination of traditional and modern fermentation processes may offer new opportunities to increase the food sovereignty at local level. Street foods - being popular forms of nourishment in West-Africa - also illustrate the potential of combining global with local food supplies and fermentation techniques. Through the consumption of street foods the rural agricultural produce and urban consumption patterns

may increasingly be connected to each other; creating a new partnership between the rural producers and urban dwellers.[6]

The aim of creating a new, different relationship between agricultural produce and local food consumption implies an effort to introduce other scientific information in the enzymes. This also implies a specific *redesign* of biocatalysts (enzymes, starter cultures) in such a way that more food can be produced and consumed locally. One example is the development of a new starter culture by the Food Research Institute in Ghana, which makes it possible to accelerate the fermentation of maize dough in two locally important products, kenkey and banku. Another example is the production of fungal spawn for mushroom production at village level (De Vries, 2002). By developing these locally-specific biocatalysts, in which global and local technological developments are combined, new direct lines between food and agricultural production, and food production and consumption are restored at local level.

The transformation of agro-industrial biotechnology into tailor made biotechnologies as a catalyst for endogenous development is also realized by challenging (and re-appropriating) another main characteristic of the agro-industrial biotechnology development: the interchangeability of resources. For example, it is known that cocoa-butter, is no longer exclusively made from cocoa, but increasingly from a broad spectrum of different oils. Nowadays, even substitutes for cocoa butter substitutes have been developed, illustrating the tendency towards an increased interchangeability of agricultural resources. However, this characteristic 'script' of agro-industrial biotechnological development can also be disconnected from the larger food industry and appropriated and modified by smallholders' organizations. Indeed, several civil society organizations are looking for opportunities to make use of new technical potentials and set up initiatives in which *waste products are converted in resources.* For example in Ghana, the cocoa husk waste products are made economically relevant for smallholder farmers by converting the cocoa husk waste into resources from which fertilizers and/or end products like the traditional soap, alata samena, are made. In one of the most important cacao producing areas in Ghana (Goaso), the production of cocoa ash from cocoa husk has been developed in such a way that now buyers from the Ivory Coast, Burkina Faso and Nigeria are buying the product for their local soap-making industry. Farmers can also maximize their cocoa revenues by no longer using the expensive palm-oil in the soap-making process but and substituting for it instead oils from the 'bad cocoa beans',

6 A specific research program will be launched at the WUR and various Southern multistakeholder platforms to investigate the potential of street foods for enhancing food sovereignty in different regions.

based on the use of cocoa husk and available now through new extraction methods (Frempong & Essegby, 2002).

Conclusion

The above-mentioned cases illustrate the multiple efforts of many various organizations in collaboration with research institutions to challenge the uncoupling of agricultural produce from local food production by setting up hybrid forms of traditional and modern preservation and fermentation techniques as well as making high-valued products from waste resources. A new locality is invented by attuning the informationalized biocatalysts to the interests of local communities. Although the hegemonic position apparently seems almost absolute and the imagination of another social embedment of modern biotechnological developments seems to be lacking, multiple initiatives are nevertheless evolving in so-called developing countries through which a re-appropriation and modification of the agro-industrial biotech development into tailor-made biotechnologies is taking place. An international network has been established to empower these initiatives by organizing an information exchange on the possibilities and constraints for changing the social/technical (material) content of traditional and modern biotechnological products and processes. A critical reflection on these efforts is needed, an exploration as to whether the agro-industrial biotechnology as an exogenous instrument can be (re)appropriated by local initiatives and modified into tailor-made biotechnologies to become catalysts for endogenous developments.

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