EMP Educação Matemática Pesquisa
ISSN 1983-3156
A
http://dx.doi.org/10.23925/1983-3156.2020v22i4p204-223

The formulation of policies building on scholarly knowledge - a study of actors in the noosphere

La formulation de politiques fondées sur les connaissances savantes - une étude des acteurs de la noosphère

Louise Windfeldt[1]
Department of Science Education, University of Copenhagen, Denmark
https://orcid.org/0000-0003-4808-5069

Résumé

Les programmes de subventions gouvernementales se basent sur le savoir savant et sont formulés dans les milieux politiques. Cette formulation introduit des changements dans le savoir. Ces changements affectent la mise en œuvre du programme de subventions et les résultats ultérieurs. Dans une étude précédente autour de la transformation et la transposition du savoir savant des ressources phytogénétiques dans un programme national de subvention, de nombreuses conditions et contraintes importantes ont été identifiées. Celles-ci sont analysées en utilisant les niveaux de codétermination didactique. Notre étude préconise que les savoirs impliqués dans ce processus doivent être soigneusement sélectionnés et désélectionnés dans la formulation de programmes de subventions, et qu'il est nécessaire de connaitre explicitement les adaptations de sensibilisation des adaptations expérimentées en raison de l'intégration dans les politiques.

Mots-clés: Transposition didactique, Connaissances savantes, Programmes de subventions gouvernementales, Ressources phytogénétiques, Niveaux didactiques de codétermination

[1] lw@plen.ku.dk

Abstract

Governmental grant-schemes build on scholarly knowledge and are formulated in political environments. This formulation introduces changes in the knowledge that affect the implementation of the grant-scheme and the subsequent outcome. In a previous study of the transformation and transposition of scholarly knowledge of plant genetic resources into a national grant-scheme significant constraints and conditions were identified. These are examined using didactic levels of co-determination. Our study advocates that knowledge must be carefully selected and deselected in the formulation of grant-schemes, and awareness of adaptations due to embedding in policies on all levels is needed.

Keywords: Didactic transposition, Scholarly knowledge, Governmental grant schemes, Plant genetic resources, Didactic levels of co-determination.

The formulation of policies building on scholarly knowledge - a study of actors in the noosphere

Governmental grant-schemes build on scholarly knowledge and are formulated in political environments. This process transforms the knowledge, which means that the subsequent implementation of the grant-scheme and thus the outcome might be affected.

The following analysis builds on a paper by Windfeldt and Bosch (in review) in which is described how scholarly knowledge of plant genetic resources is transformed into a national grant-scheme to support public demonstration-projects.

Plant genetic resources (PGR) include all plant-varieties of actual or potential value for agriculture (FAO, 2009). To conserve, grow, and develop PGR in a sustainable way requires political and economic backing worldwide. Therefore almost all nations have signed the legally binding International Treaty on PGR (FAO-treaty) in FAO, the Food and Agriculture Organization of the United Nations (FAO, n.d.). FAO requires the political backing to be based on public awareness and support, stating:

> In spite of the enormous contribution by PGR to global food security and sustainable agriculture, its role is not widely recognized or understood. Greater efforts are needed to estimate the full value of PGR, to assess the impact of its use and to bring this information to the attention of policy-makers and the general public so as to help generate the resources needed to strengthen programs for its conservation and use (FAO, 2010, p. 198).

A Danish grant-scheme: 'Grant for demonstration projects about conservation and sustainable use of plant genetic resources' (Grant PGR) was initiated in 2008 by the Danish Ministry of Food, Agriculture and Fisheries [the Danish Ministry of Food] and embedded in the European Union's (EU's) Rural Development Policy 2007 to 2013. The aim of the Grant PGR was firstly to protect plant genetic resources for food and agriculture by supporting demonstration-projects; secondly to test the suitability for environmentally friendly farming and food products; finally the grant-scheme should help

fulfil international obligations according to FAO, and increase public awareness of plant genetic resources (the Danish Ministry of Food, 2007 and 2011).

Windfeldt and Bosch found that some of the scholarly knowledge of PGR was reconstructed to be incorporated in the grant-scheme, while some was not used, and elements not belonging to the scholarly knowledge were added. Main external actors influencing the formulation process in the Ministry of Food were the EU and FAO since the grant-scheme was embedded in EU's Rural Development Policy, and one of its purposes was to help fulfil international obligations according to FAO (Windfeldt and Bosch, in review).

In the present paper we will examine these external actors in the transformation process by asking:

- Can conditions concerning PGR in FAO and the EU be described as belonging to a hierarchy of levels?
- Can these levels explain the origin and manifestation of some of the most important conditions and constraints in the Grant PGR?

Theory

We use the anthropological theory of the didactic (ATD): didactic transposition and levels of co-determination as analytical tools, because these make it possible to analyze a difficult process of knowledge transformation with many factors influencing the process.

Didactic transposition

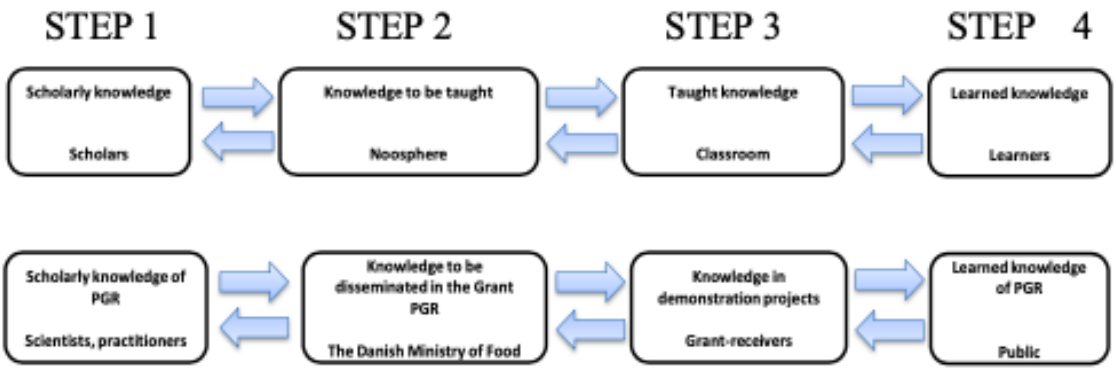
Although the framework of didactic transposition was originally developed in mathematics education research (Chevallard, 1985), it has been used to explain the transformation of knowledge in other subjects (e.g. Hazzan, Dubinsky, & Meerbaum-Salant, 2010; Banegas, 2014). It can also be used to explain the transformation of

knowledge in other contexts, for instance to study how museums create educational environments on the basis of certain objects of scientific knowledge, which they wish to mediate to their visitors (Simonneaux and Jacobi, 1997; Mortensen 2010).

Windfeldt and Bosch used didactic transposition to gain an overview of the transformation and transposition of knowledge in the formulation of the Grant PGR. In figure 1 the process is explained in relation to the similar process of school teaching.

Figure 1

Comparison of the didactic transposition of knowledge in a school-context (upper line) and the Grant PGR (lower line): In the Grant PGR the knowledge presented by scientists and practitioners (step 1) is transposed to knowledge to be disseminated by the Danish Ministry of Food in the Grant PGR (step 2), by the grant-receivers in the demonstration projects (step 3), and finally learned by the public (step 4) (Windfeldt & Bosch, in review)



Windfeldt and Bosch analyzed the process shown in figure 1 from step 1 to step 2.

They found that the *scholars* were scientists and practitioners: agriculturists, plant breeders, geneticists, gardeners, farmers, and chefs. The scholars' knowledge about how plants can be examined, grown, and used makes up the *scholarly knowledge of PGR*. The main subjects which formed the scholarly knowledge were studied in a broad literature review and organized into four relatively independent categories: 'genes', 'resources', 'agriculture', and 'policy'.

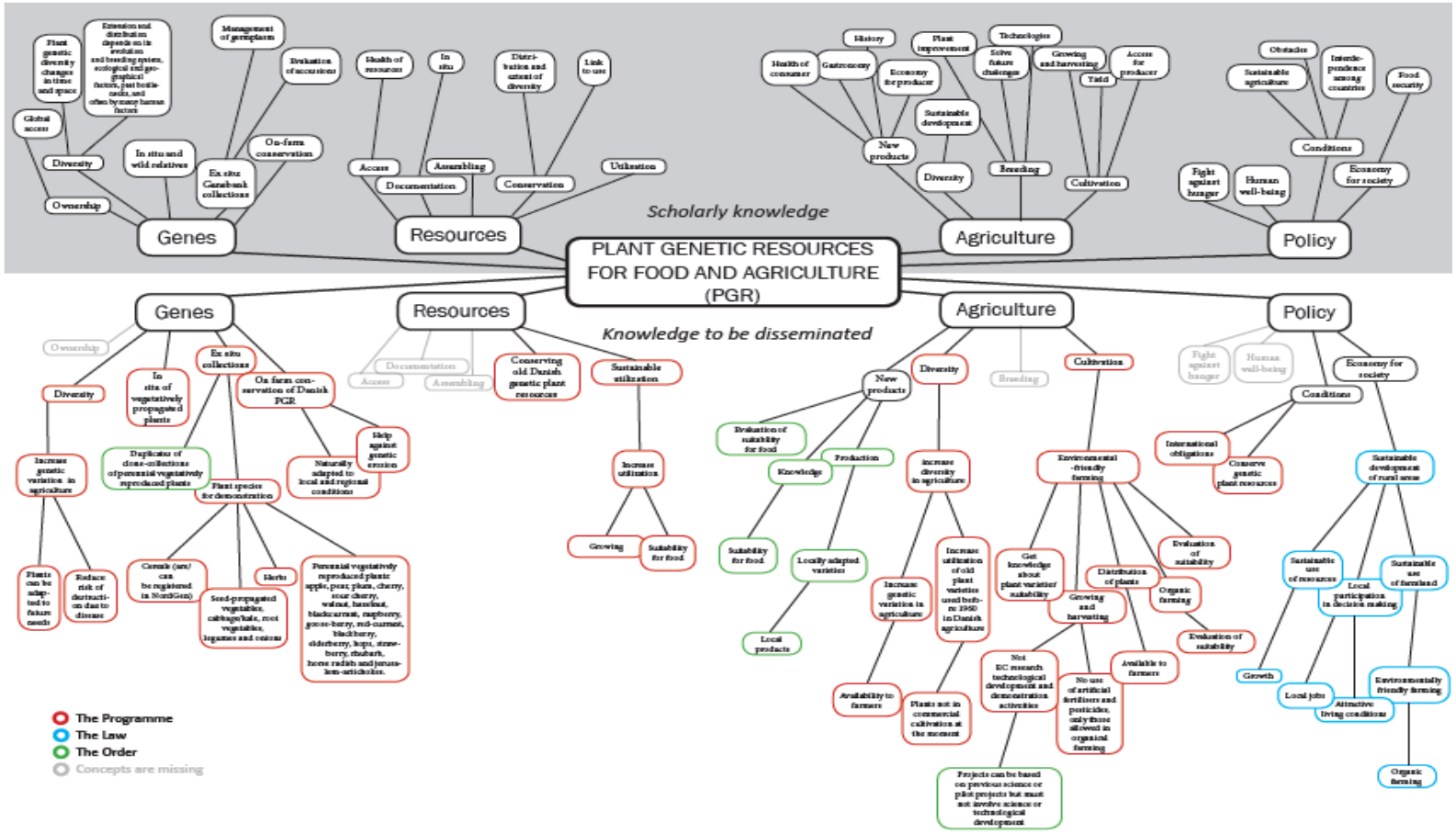
Step 2 in the didactic transposition process is *knowledge to be taught* in the noosphere, which was organized around the Ministry of Food since it sat up the conditions for the Grant PGR. Knowledge to be taught consisted of a programme, a law, and an order in the Danish Ministry of Food (The Danish Ministry of Food, 2007, 2011, and 2012).

The main subjects in the process of didactic transposition (step 1 and 2) can be seen in figure 2 (Windfeldt and Bosch, in review).

EMP Educação Matemática Pesquisa
ISSN 1983-3156
A
http://dx.doi.org/10.23925/1983-3156.2020v22i4p204-223

Figure 2

Concept map showing the didactic transposition process of knowledge of PGR from step 1 (scholarly knowledge - upwards) to step 2 (knowledge to be disseminated - downwards) (Windfeldt & Bosch, in review).



EMP Educação Matemática Pesquisa
ISSN 1983-3156
A
http://dx.doi.org/10.23925/1983-3156.2020v22i4p204-223

Windfeldt and Bosch found that the transposition process led to changes in the scholarly knowledge. Three important constraints were found in the category of 'Agriculture':

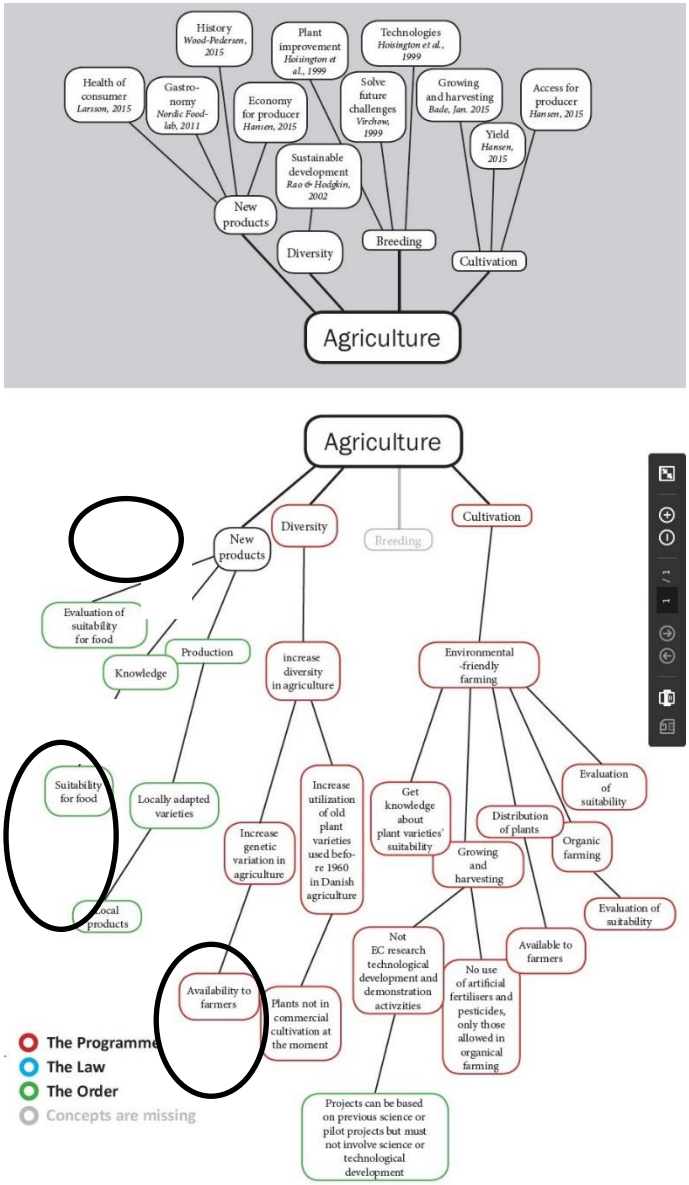
1. Solely old varieties of plants could be demonstrated in the Grant PGR
2. Breeding, research, and technological development were not part of the Grant PGR
3. No use of pesticides was allowed in the Grant PGR

These can be seen in detail in figure 3.

Using levels of co-determination, we will in the following examine how the three conditions seen in figure 3 were selected to be part of the Grant PGR.

Figure 3

Concept map showing the changes in knowledge of 'agriculture' from scholarly knowledge (upwards) to knowledge to be disseminated (downwards) in the Grant PGR. The numbered circles refer to text above (Windfeldt & Bosch, in review)



Levels of co-determination

Conditions and restrictions that affect dissemination of knowledge in the noosphere have been described as belonging to a hierarchy of levels of co-determination in the ATD. This was originally developed to analyze the factors that influence the design and outcomes of teaching-learning situations in schools. The uppermost levels are

'humanity', 'civilization', 'society', and 'school' (Chevallard, 2017; Bosch & Gascón, 2006; Artigue & Winsløw, 2010).

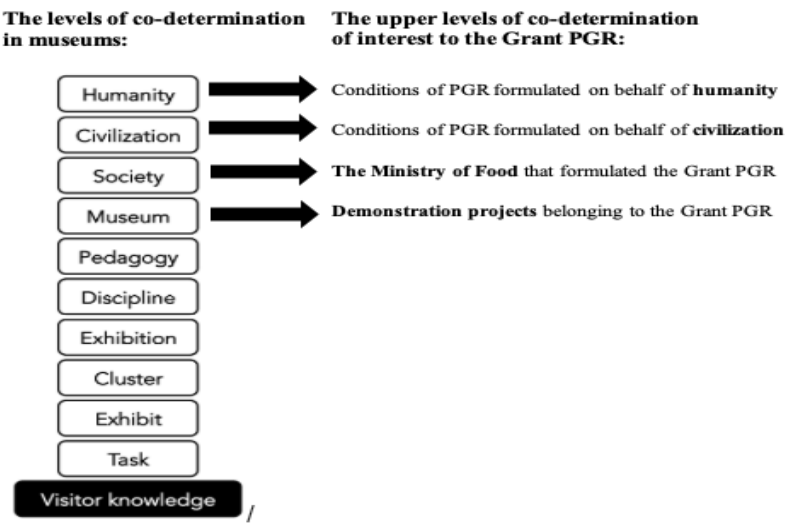
Achiam and Marandino (2014) adapted the framework to museum contexts to study the design and educational outcomes of exhibits. According to Achiam and Marandino (forthcoming) humanity, civilization, and society refer to constraints and conditions to museum practice that originate or manifest themselves externally to the institution itself.

The Grant PGR supported public demonstration-projects. As an important purpose of the demonstration-projects was to raise public awareness of PGR they can be seen as informal learning environments, disseminating knowledge like museums.

In the following we will use the three upper levels of co-determination to analyze whether the conditions concerning PGR in FAO and the EU can be described as belonging to a hierarchy of levels. This is seen in figure 4.

Figure 4

Left: The levels of co-determination in museums (from Achiam and Marandino, forthcoming). Right: The upper levels of co-determination are used to analyze the formulation of the Grant PGR.



Next we will study how these levels can explain the origin and manifestation of the three constraints (see figure 3) chosen from the Grant PGR.

Results

To analyze whether the conditions concerning PGR in FAO and the EU can be described as belonging to a hierarchy of levels we will start by studying the two upper layers of co-determination: 'humanity' and 'civilization' to see how they relate to PGR.

Conditions of PGR formulated on behalf of humanity

According to the Merriam-Webster Dictionary humanity refers to "the totality of human beings; the human race". Conditions described on this level must be expressed on behalf of mankind.

In the case of PGR we find conditions described in the legally binding FAO-treaty on this level. The treaty defines PGR as "any genetic material of plant origin of actual or potential value for food and agriculture" (FAO, 2009, Article 2). The treaty is signed by 140 of 193 independent nations, and according to the FAO-treaty each country must take care of PGR that are under threat (FAO, 2009). It states that:

> The conservation, exploration, collection, characterization, evaluation and documentation of plant genetic resources for food and agriculture are essential in meeting the goals of the Rome Declaration on World Food Security and the World Food Summit Plan of Action and for sustainable agricultural development for this and future generations. (Fao, 2009, Preamble)

It furthermore explains that:

> Plant genetic resources for food and agriculture are the raw material indispensable for crop genetic improvement, whether by means of farmers' selection, classical plant breeding or modern biotechnologies, and are essential in adapting to unpredictable environmental changes and future human need (Fao, 2009, Preamble).

All these global issues (e.g. ‘World Food Security’, ‘future generations’, ‘environmental changes’, and ‘future human need’) must be seen as expressed on behalf of mankind.

Conditions of PGR formulated on behalf of civilization

According to Artigue & Winsløw (2010) civilization is a culturally homogenous group of societies, and their values cover their principles for human society.

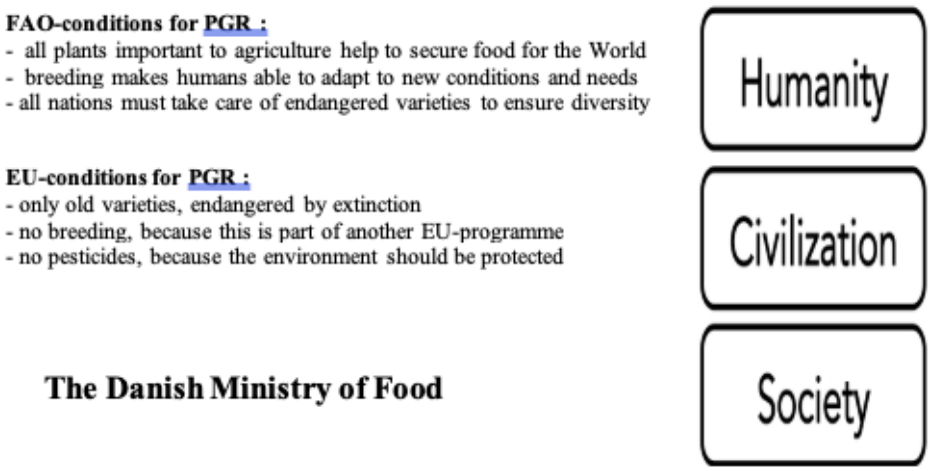
In the case of PGR we find conditions described by the EU (the European Union with 26 European nations formed in 1993 for the purpose of achieving political and economic integration) on this level. Protection of genetic diversity was from the first implementation of EU’s Common Rural Development Policy in 1992 one of the focus areas (Commission of the European Communities, 1992). This was due to a concern that varieties of useful plants were threatened with genetic erosion, because they were not competitive against the modern high-producing varieties (European Commission, 1998). The focus on PGR should thus enhance biodiversity in agriculture and was part of encouraging farmers and other land managers to introduce or continue “to apply agricultural production methods compatible with the protection and improvement of the environment, the landscapes and its features, natural resources and the soil. In this context the conservation of genetic resources in agriculture should be given specific attention” (European Commission, 2005: 35).

The focus on PGR as a part of an environmental focus and due to the concern that varieties of useful agricultural plants were endangered, because they were not competitive against modern high-producing varieties, express the values and conditions of a limited and culturally homogenous group of societies (the EU), and are thus on the level of civilization.

Using levels of co-determination figure 5 shows how the conditions concerning PGR can be described. Conditions described by FAO express values on the level of humanity, while the conditions described by the EU belong to a culturally homogenous group of societies, which are described by the level of civilization.

Figure 5

Conditions concerning PGR in FAO and the EU can be described as belonging to a hierarchy of levels. Conditions described by FAO express values at the level of humanity, while the conditions described by the EU belong to the level of civilization. On the third level is the Danish Ministry of Food. All belong to the noosphere in the formulation of the Grant PGR



The origin of the three important constraints

We will now see how levels of co-determination can be used to explain the origin and manifestation of the three constraints.

1. Solely old varieties of plants could be demonstrated in the Grant PGR

While the FAO-treaty at the level of humanity states that PGR include all plant-varieties of value for agriculture to secure food for the World (FAO, 2009), it was decided to limit the plants that could be demonstrated in the Grant PGR to old, Danish varieties. This was due to the concern that they were endangered, because they were not competitive against modern high-producing varieties. This constraint belongs to the level of civilization as it expresses the values and conditions of a culturally homogenous group of

societies. It came from the Rural Development Programme and was an adaptation of the Grant PGR to EU's Rural Development Policy 2007 to 2013.

2. Breeding, research, and technological development were not part of the Grant PGR

While the FAO-treaty at the level of humanity states that PGR are the raw material indispensable for crop genetic improvement, which includes plant breeding, and thus makes humans able to adapt to unpredictable environmental changes and future human needs (FAO, 2009), breeding was not mentioned in the Grant PGR. This was because research and technological development, which includes breeding, was part of another EU framework-programme, and in the Rural Development Programme "support may not be given for initiatives that are eligible under the Community Framework Programme for Research and Technological Development" (the Danish Ministry of Food, 2012, p. 241). Thus the decision that breeding could not be used and demonstrated in the Grant PGR expresses the values and conditions of a more limited, culturally homogenous group of societies (the EU), and are thus on the level of civilization. The Danish Ministry of Food had to integrate this constraint into the Grant PGR, when they decided to make it part of the Rural Development Programme in EU's Rural Development Policy 2007 to 2013.

No use of pesticides was allowed in the Grant PGR

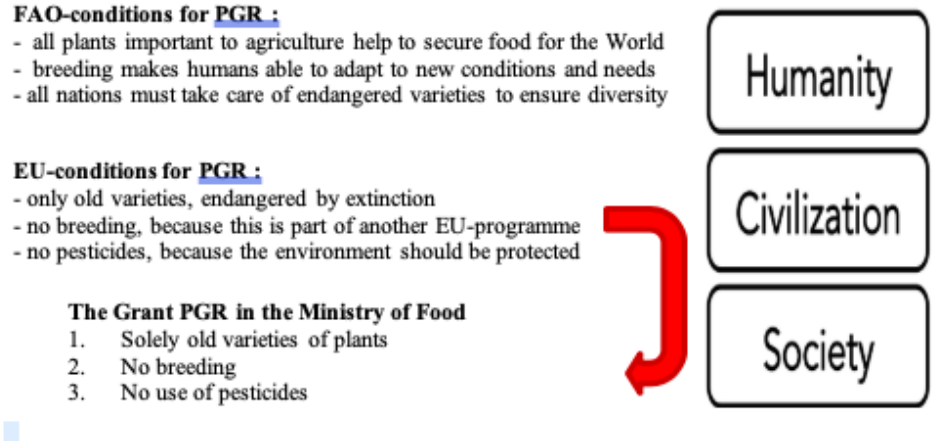
The decision that no use of pesticides were allowed in the Grant PGR was one of the three key areas in EU's Rural Development Policy 2007 to 2013 (The Council of the European Union, 2006). Thus conservation of genetic resources in agriculture was made a part of the context, where farmers and other land managers should: "apply agricultural production methods compatible with the protection and improvement of the environment" (European Commission, 2005: 35). Though protection of the environment could be argued to be a concern on the level of humanity, the use of pesticides might sometimes

be necessary when conserving fragile varieties. That each country must take care of PGR that are under threat (FAO, 2009) is here seen as more important for humanity than protecting the environment. Thus the decision that pesticides were not allowed is seen as a decision taken on the level of civilization.

The conditions belonging to the upper levels of co-determination that influenced the formulation of the three important constraints can be seen in figure 6.

Figure 6

The uppermost levels of co-determination in the formulation of the Grant PGR: FAO-conditions of PGR belong to the humanity level, and EU-conditions to the level of civilization. These two uppermost levels influenced the formulation of the Grant PGR in the Danish Ministry of Food



Discussion

A governmental grant-scheme is an instrument of policies, which the government wants to promote by giving out money. Therefore, it is not surprising that conditions originating outside the Grant PGR have influenced its formulation. We showed that conditions coming from the EU manifested themselves in the Grant PGR by using levels of co-determination. But can these levels also explain the appropriateness of the conditions? And could levels of co-determination be used in guiding better decisions? In the following we will discuss this for the three constraints:

Solely old varieties of plants could be demonstrated in the Grant PGR

No one would claim that showing a narrow collection of old plant varieties under threat of extinction, would be the best way to increase public awareness of plant genetic resources compared to showing a broad diversity of edible plants, including the most common crops. But the EU concern that varieties of useful plants were threatened with extinction because they were not competitive against modern high-producing varieties (European Commission, 1998) became more important than showing a broad diversity and thus only old plant varieties under threat of extinction could be demonstrated.

Breeding, research, and technological development were not part of the Grant PGR

As stated by FAO plant genetic resources for food and agriculture are the raw material indispensable for crop genetic improvement, which includes breeding. This is essential in adapting to unpredictable environmental changes and future human needs (FAO, 2009).

That breeding could not be part of the Grant PGR was not because this was considered unimportant. It was just a coincidence that breeding belonged to another EU-programme dealing with research and technological development, which prohibited use in the actual programme. Thus, breeding could not be part of the Grant PGR. This limited the opportunity to increase public awareness of the importance of breeding.

No use of pesticides was allowed in the Grant PGR

That pesticides could not be used in the Grant PGR was due to an EU focus on the environment and thus on agricultural production methods compatible with the protection and improvement of the environment (European Commission, 2005). But though organic farming will help the environment on a large scale it is problematic to conservation of single plant varieties. When preserving plants, and establishing

collections and duplicates, it might sometimes be necessary to use pesticides to conserve all varieties; especially the fragile ones. Thus a requirement that only plant protection products approved for organic farming may be used in the Grant PGR is problematic to conservation, which was the first aim of the grant-scheme and central to FAO-goals.

Conditions on the level of humanity was over-ruled by conditions on the level of civilization

Though PGR-conditions described by FAO belonged to the highest level of co-determination, it was PGR-conditions described by the EU that manifested themselves in the formulation of the Grant-PGR. Thus it became more important to fulfill EU-goals and -rules than following the FAO-treaty, which acts on behalf of mankind.

The decision to implement EU-conditions in the Grant PGR led to constraints. These restricted the fulfillment of the Grant PGR, especially protection of plant genetic resources and raising public awareness in the demonstration projects. Looking to the humanity-level instead, PGR-conditions in the FAO-treaty could guide to better decisions in the formulation of the Grant PGR. This would lead to a better implementation of the grant-scheme and a subsequent better outcome of the demonstration projects:

Pesticides should be allowed in the demonstration projects to conserve fragile varieties of PGR in gene-banks and clone-collections. Conservation of PGR are essential for sustainable agricultural development and thus to secure world food security for this and future generations (FAO, 2009). Therefor it is more important that each country takes care of PGR that are under threat than keeping pesticides 100% out of the environment.

Breeding should be part of the demonstration-projects to show PGR as the "raw material indispensable for crop genetic improvement" (FAO, 2009, Preamble) and how they are "essential in adapting to unpredictable environmental changes and future human need" (FAO, 2009, Preamble). If this was not possible according to the EU legislation another solution could have been adding a statement to the grant-scheme that though it

was not intended to fund research itself, collaboration to research and breeding was allowed and would be encouraged.

A broader variation of plants could be demonstrated to increase public awareness and interest in conservation of PGR. This would show the development of varieties and the connection between former, present, and future agriculture. This would also make it easier to disseminate knowledge of why it is essential to preserve the broadest possible variation and thus fulfill obligations according to FAO.

Concluding remarks

We have studied how scholarly knowledge about conserving and growing food plants in a sustainable way was rebuilt into a grant-scheme. This introduced changes in the knowledge due to the adaptation to EU's Rural Development Policy, which negatively affected the implementation of the grant-scheme and the subsequent outcome.

The analysis indicates that policy makers must be explicit about the knowledge they select and deselect in the transposition process and aware of political agendas on all levels.

Didactic transposition and levels of co-determination serve as useful analytical tools, which could also be appropriate in similar cases, where an object of knowledge is transposed from a scholarly environment to a political environment, and built into for instance a law. This can lead to more explicit choices in the development of grant-schemes, laws, programs, and other political instruments building on a body of scholarly knowledge.

Acknowledgements

I would like to thank Caroline Ladage, Marianne Achiam, and Britta Eyrich Jessen for very helpful comments on earlier versions of this paper.

References

Achiam, M., & Marandino, M. A framework for understanding the conditions of science representation and dissemination in museums. *Museum Management and Curatorship* 29, p. 66-82, 2014

Achiam, M., & Marandino, M. Intended and realised biological themes of dioramas: An international comparison. *Natural history dioramas: Traditional exhibits for current educational theme*s. Vol. II: Socio-cultural aspects. Dordrecht: Springer, forthcoming.

Artigue M & Winsløw C International comparative studies on mathematics education: A viewpoint from the anthropological theory of didactics. *Recherches en Didactique des Mathématiques* 30, p. 47-82, 2010

Banegas, D. Democratizing didactic transposition: negotiations between learners and their teacher in a secondary school. *Latin American Journal of Content and Language Integrated Learning*, 7(2), p. 1–2, 2014. https://doi.org/10.5294/laclil.2014.7.2.1

Bosch, M., & Gascón, J. Twenty-five years of the didactic transposition. *ICMI Bulletin*, 58, p. 51–63, 2006.

Chevallard, Y. *La transposition didactique : du savoir savant au savoir enseigné*. Grenoble : la Pensée sauvage, 1985.

Chevallard, Y. La TAD et son devenir : rappels, reprises, avancées. In: *Évolutions contemporaines du rapport aux mathématiques et aux autres savoirs à l'école et dans la société*, p. 27-65, 2017. https://citad4.sciencesconf.org

Commission of The European Communities Council Regulation (EEC) No 2078/92/EEC of 30 June 1992. *Official Journal of the European Communities* 215, p. 85-90, 1992

European Commission State of application of regulation (EEC) no. 2078/92: *Evaluation of agri-environment programmes* (DGVI COMMISSION WORKING DOCUMENT No. VI/7655/98), Brussels, 1998.

European Commission Council Regulation (EC) No 1698/2005 of 20 September 2005 on support for rural development by the European Agricultural Fund for Rural Development (EAFRD*), Official Journal of the European Union*, Brussels, 2005. http://eur-lex.europa.eu/legal-content/EN/TXT/HTML/?uri=CELEX:32005R1698&

Fao (n.d.). List of Countries | The International Treaty. Retrieved October 29, 2015. http://www.planttreaty.org/list_of_countries

Fao *International Treaty on Plant Genetic Resources for Food and Agriculture*. IUCN, 2009. http://www.planttreaty.org/content/texts-treaty-official-versions

Fao The Second Report on the State of the World's Plant Genetic Resources for Food and Agriculture. Rome: *Commission on Genetic Resources for Food and Agriculture, Food and Agriculture Organization of the United Nations*, 2010.

Hazzan, O., Dubinsky, Y., & Meerbaum-Salant, O. Didactic transposition in computer science education. *ACM Inroads*, 1(4), p. 33, 2010. https://doi.org/10.1145/1869746.1869759

Mortensen, M. F. Museographic Transposition: The Development of a Museum Exhibit on Animal Adaptations to Darkness. *Éducation et Didactique*, 4(1), p. 115–138, 2010. https://doi.org/10.4000/educationdidactique.763

Simonneaux, L., & Jacobi, D. Language constraints in producing prefiguration posters for a scientific exhibition. *Public Understanding of Science*, (6), p. 383–408, 1997.

The Council of The European Union Council Decision of 20 February 2006 on Community Strategic Guidelines for Rural Development (programming period 2007 to 2013), *Official Journal of the European Union*, 2006.

The Danish Ministry of Food, Agriculture and Fisheries Law for Development of Rural Areas, 2007. *Lov om udvikling af landdistrikterne* (landdistriktsloven), 2007.

The Danish Ministry of Food, Agriculture And Fisheries *Bekendtgørelse om tilskud til demonstrationsprojekter om bevaring og bæredygtig udnyttelse af plantegenetiske ressourcer for jordbrug og fødevarer* - retsinformation.dk, 2011. https://www.retsinformation.dk/Forms/R0710.aspx?id=123370

The Danish Ministry of Food, Agriculture And Fisheries *The Danish Rural Development Programme 2007-2013*, 2012.

https://naturerhverv.dk/fileadmin/user_upload/NaturErhverv/Filer/Tilskud/Projekttilskud/Landdistrikter/LDP_Rev_proposal_Consolid_2007-2013f.pdf

Windfeldt, L & BOSCH, M *Demonstration of Plant Genetic Resources for Food and Agriculture to the public in a national grant-scheme - Transferring knowledge from a scholarly context to a policy context*. Manuscript in review, 2017.