Open Source, Commons and Development
A Research Agenda on Common Pool of Services of Generation Challenge Programme (GCP)

Soutrik Basu[1], Guido Ruivenkamp[2], Joost Jongerden[3]

ABSTRACT

This article discusses a new research agenda on open source commons in life sciences and its interrelationship with development discourses. The main research question for this article is: why it is important to have a research project on open source and commons? The paper starts with a historical review of the seed germplasm characteristics and its transformation in twentieth century, followed by the rise and problems of the plant patent acts and intellectual property regimes. This is used as a background for the emergence of a new trend in knowledge production based on sharing knowledge. It is argued here that the sharing mechanism is a new trend in academic discourses and it has strong potential for facilitating innovation and inclusive technology development, as a result a systematic study is needed to investigate the potential. Moreover, sharing and commonly produced knowledge are always succumbed for private appropriation and how commonly produced knowledge remain common is also an important motivation for this project. In order to perform a research on open source and commons, Generation Challenge Programme is proposed here because of its international networking for improving crop genetic diversity, upstream-downstream connection, and development commitment. Subsequently the theoretical and methodological issues are also discussed.

***Key Words**: open source; commons; knowledge commons; innovation; development; technology studies*

1 INTRODUCTION

The crop genetic resources or the seed germplasm used to be a common property and considered to be the 'common heritage of human kind' (Fowler 2000). As a result the farmers and breeders were independent enough to conduct experiments with the seed germplasm without any proprietary restrictions. However, with the advancement in the science and technology of plant breeding coupled with a series of plant protection acts since 1930, the nature of the seed germplasm transformed from common property to a sovereign property. This process of transformation culminated into and exacerbated through intellectual property rights (IPR) dominated regime. In a word, within this IPR too many people hold the key to exclude others from experimenting with the crop genetic resources. These stringent property regimes created severe problem in the pace of invention and innovation within agrarian domain. As a result a debate has been conceived within the international arena which focuses to device ways to go beyond the IPR regime. Out of this debate a new trend of knowledge production evolved which is based on sharing rather than protecting. This trend is popularly known as the open source and commons paradigm. The objective of this paper is to justify a new research agenda

[1] PhD Researcher (AIO), Critical Technology Construction, Wageningen University, The Netherlands
[2] Professor and Head, Critical Technology Construction, Wageningen University, The Netherlands
[3] Assistant Professor, Critical Technology Construction, Wageningen University, The Netherlands

on open source and commons that has been taken up by the chair group Critical Technology Construction (CTC) of Wageningen University. In other words, this article aims to investigate the fact why it is important to have an interdisciplinary research program on open source and commons.

In order to explain our research agenda on open source and commons this paper starts with a brief discussion on the transformation process of crop genetic resources from common heritage of human kind to sovereign property. This discussion will situate the relevance of open source and commons to the wider academic trends. This is followed by an overview of emergence of open source and commons paradigm in the recent and contemporary academic debate. After this initial discussion the paper will briefly reflect on the rationale of this research program. This research rationale will acquaint the reader about the unique preamble that as a chair group we are concerned about open source and commons. In the next section we will discuss the possible theoretical niches and methods that would be implemented as well as expected to be redeveloped after the research. Finally the ideas will be summed up in the concluding section.

2 FROM COMMON HERITAGE TO SOVEREIGN PROPERTY

Globally, farmers used to enjoy a complete sovereignty over their genetic resources till 1930 (Kloppenburg 2010). Farmers used to exchange, plant, save, and distribute the seed germplasm without any proprietary restrictions. Crop genetic resources were managed by the loose set of rules which were generally established by the cultural norms of the community and operated on the bases of reciprocity and gift exchange rather than any market mechanism (Brush 2004; Salazar, Louwaars, and Visser 2007). The idea was that the seed germplasm is a product of nature and considered as a part of common heritage of humankind in which no community, state, or organization have exclusive proprietary right to own it (Thompson 2004).

However, the science and technology of plant breeding underwent through a quick transformation with the rediscovery of Mendels's work on plant and genes in early twentieth century (Dutfield 2003; Kloppenburg 1988). Hence, the science of plant breeding progressed rapidly in twentieth century resulting into the development of hybrid varieties and eventually culminated into the development of the genetically modified crops (GMCs). Development of the hybrid varieties paved the way for the private companies to strengthen their position into the agricultural sector and gradually transformed into a life-science industry dominating the seed sector (Kloppenburg 1988, 2004; Ruivenkamp 1989; Ruivenkamp 2005). With this privatisation in agriculture and more reliance of farmers on hybrid varieties the demand for intellectual property right in plant genetic resources initiated. As a result a number of patent act were passed nationally as well as internationally at the end of twentieth century. These acts includes: Plant Patent Act (PPA)of 1930 in the USA, International Union for Protection of New Varieties of Plant (UPOV) of 1961 in Europe, Plant Variety Protection Act (PVPA) of 1970 in the USA and finally the Trade Related Aspects of Intellectual Property Rights (TRIPS) of the World Trade Organization in 1995 mandated for its member countries that the plant genetic resources (PGR) be accorded either plant variety protection, patent or effective

protection under a *sui generis* system (Aoki 2009)[4]. Initially the farmers' and breeders were exempted from the proprietary regulations, however these exemptions to farmers and breeders were curtailed considerably in the recent times. Thus the seed germplasm which used to be a common property or common heritage of humankind became a sovereign property under the control of multinational corporate bodies. Through this process also the agriculture was disconnected with the nature and depends much on the international multinational companies (Ruivenkamp 2005, 2008; Ruivenkamp, Hisano, and Jongerden 2008).

3 EMERGENCE OF A NEW TREND IN AGRARIAN KNOWLEDGE PRODUCTION

Advancement in the science and technology of plant breeding has led to the use of multiple research tools for new crop development (Nottenburg, Pardey, and Wright 2002). These tools include: specific genes, promoters, markers, functional information, and other enabling technologies (Hope 2004). Moreover the advance technologies of plant breeding are often an agglomeration of several disciplines like agronomy, crop genetics, breeding, pest control, agro-ecology and so on and so forth (Graff and Zilberman 2005). As a result innovation in agricultural technology is both cumulative and complementary in nature as the new innovation is often build on the previous innovation as well as it contains several elements from different sources (Mazzoleni and Nelson 1998).

These multiple sources or the research tools of science and technology of plant breeding are subjected to the proprietary controls (Hope 2004). More specifically, the molecular breeding techniques which holds the key in genetic engineering are more vulnerable for the intellectual property protection (Graff and Zilberman 2001). As a result the demand as well as the grant of patents in plant breeding technology rose very high under the Patent Co-operation Treaty in the USA, Europe and Japan (Atkinson et al. 2003). The international agreements forces the national governments to include some sort of intellectual property rights to the plant genetic resources (Blakeney 2009). This incident eventuated in several overlapping claims over the genetic resources and often the example of golden rice is given which has approximately 70 different patented technologies (Nottenburg, Pardey, and Wright 2002).

In the context of agriculture and plant breeding user-innovation by the farmers generally played an important role in developing new varieties and improving the existing varieties. However, with the advent of the strict intellectual property regime and the reliance on multinational companies for hybrid seeds - so that farmers can't replant a part of their harvest- the user-innovation process by farmers is being impeded. This phenomena turned the farmers into a passive receiver and a mere user of technology, while the indigenous knowledge on agriculture- which is more suited for the local environment- often excluded in the development of new varieties.

On the upstream research level, with the patent system there is a possibility of underuse as too many people holds the right to exclude others. The "tragedy of the

[4] Authors here are not interested to explain the details of these several laws rather to indicate to the fact that through these several legal stipulations the plant genetic resources were appropriated by the corporate. Readers who are interested to know the details of this legal issues may refer to (Aoki 2009).

anti-commons" refers to the more complex obstacles that arise when a user needs access to multiple patented inputs to create a single useful product. Each upstream patent allows its owner to set up another tollbooth on the road to new development adding to the cost and slowing the pace of invention (Heller and Eisenberg 1998).

So the problem with the extensive patent system can broadly be divided into two categories: *impeding the user innovation* and *slowing and creating inconvenience for invention in the upstream level*. Recently, many authors, policymakers, and NGO activist suggest that the paradigm of open source and commons can considerably play a role in the above mentioned problems. Instead of protecting the knowledge, sharing is becoming more important. But how far and what possibilities do the open source and commons offer in respect to user innovation is researched by CTC in four projects[5] of which an analysis of the Generation Challenge Program is one of them.

4 RESEARCH RATIONALE

The concept of open source and commons is relatively new in the academic discourses and gained importance recently. It evolved out of the stringent proprietary regimes which often impede the user innovation for the farmers and create many stumble blocks in the process of technology development. Promoters of Open source and commons within the domain of plant sciences as well as the first hypothesis suggests that the open source and commons have the potential for inclusive agricultural technology development which are more attuned towards the location specific social and ecological needs (Ruivenkamp and Jongerden 2010). Moreover, it also has the potential to facilitate the user innovation and it will challenge the user to become co-innovators. However, there is a paucity of academic as well as empirical records of the above postulates. In other words, no systematic studies were conducted on the functioning and application of open source and commons within the domain of plant sciences and agricultural development. This research is undertaken to fill the gap as it aims to understand the functioning of open source and commons paradigm within the plant sciences discipline by researching the process of open source knowledge development, the production of the knowledge commons, and its application in developing new crop varieties.

The following two very strongly interrelated and intertwined research lines need to be addressed in order to disentangle the full potential of open source and commons within plant sciences domain: *governance* and *application* of open source and commons. The axiom 'governance' refers how open source and commons consortium is developed, improved, managed, and administered? What are the underlying principles of production, distribution, and accusation of knowledge within the consortium? What are the eventualities of commonly produced knowledge? While addressing these questions these two statements will be juxtaposed: 'knowledge commons are always succumbed to appropriation' and 'knowledge commons remained within the public domain'. By juxtaposing these two statements

[5] The CTC study group on Open source and Commons is comprised of 4 PhD students: Mithun Bantwal Rao, Archana Patnaik, Divya Rao, and Soutrik Basu, supervised by Guido Ruivenkamp and Joost Jongerden. Different issues pertaining to open source and commons like Arabidopsis Network, Cambia-Bios, ICRISAT, and GCP will be studied. This research programme is funded by the NWO-WOTRO of the Netherlands government.

this research is expected to contribute to a very important question pertaining to the commons debate that how commonly produced knowledge remains commons? The notion of application on the other hand refers to the developmental activities. It considers issues related to innovation by farmers, incorporating local knowledge in new agricultural technologies, inclusive technology development, improving participatory plant breeding programmes, etc. In other words different case studies will be made to reflect these issues through open source and commons approach within agricultural development. In other words, how and what possibilities do open source and commons offer for inclusive technology development that are better attuned towards the local needs as well as encourage innovation at the bottom level?

In order to conduct an exploratory research to the problems mentioned above, we need a research phenomenon where a systemic study can be conducted. In this proposal we propose the Generation Challenge Programme (GCP) of the Consultative Group of International Agricultural Research (CGIAR) as a research phenomenon. At this point a short note on GCP is worthwhile for the readers.

5 GENERATION CHALLENGE PROGRAM (GCP)

The Generation Challenge Programme (GCP) is one of the five challenge programmes of the Consultative Group of International Agricultural Research (CGIAR). It was created by CGIAR in 2003 as a time-bound 10 year programme and its aim is to add value to crop breeding, targeting farmers in drought prone and harsh environments. GCP's mission is to use plant genetic diversity, advanced genomic science and comparative biology to develop tools and technologies that will support plant breeders in the developing world in their efforts to produce better crop varieties for resource poor farmers in drought-prone environments. The GCP is at the heart of a research and capacity building network that uses plant genetic diversity, advanced genomic science and comparative biology to develop tools and technologies that help plant breeders in the developing world produce better crop varieties for resource-poor farmers. GCP's activities are organised into five overlapping and interactive sub-programmes: the genetic diversity of global genetic resources; comparative genomics for gene discovery; trait capture for crop improvement; bioinformatics and crop information systems; capacity-building and enabling delivery (CIMMYT, IPGRI, and IRRI 2003; GCP 2007, 2010; Vroom 2010).

As it appears from the website, GCP is unique within CGIAR and the larger agricultural research –for-development community. It was founded to unlock the potential of plant genetic diversity as a means to modernise crop improvement programmes so that these serve the resource poor. GCP is focused on drought tolerance which affects almost many crops in many regions of the world. GCP relies on a network that can enable it to exploit significant resources –funds, skills, equipment, knowledge and social capital-through partnerships with public and private institutions and initiatives. A critical benefit of the network is that it provides access to vast stores of plant genetic resources as well as to the cutting-edge technologies and scientific expertise needed to make these resources more useful for crop improvement. GCP's network structure is a useful model for overcoming some of the traditional barriers that tend to frustrate innovation in established R&D systems, such as broken links between basic and applied research, and weak partnerships between advanced research institutions and national programmes in

developing countries (CIMMYT, IPGRI, and IRRI 2003; GCP 2007, 2010; Vroom 2010).

GCP research products are delivered to other researchers (including gene bank curators, plant physiologists, geneticists, breeders and others) to enhance the efficiency of plant breeding programmes in developing crop varieties with traits that match the needs of resource-poor farmers in marginal environments. More precisely within GCP there are several platforms like Genotyping Support Services (GSS), Molecular Breeding Platform (MBP) and Genetic Resources support Services (GRSS) which create a set of plant breeding support services as sustainable public goods. These platforms facilitate access by developing world breeders to modern plant science technologies at optimal cost and with logistical and technical support (GCP 2010, 2010).

GCP's support for developing new knowledge and products to increase food production directly addresses the UN's Millennium Development Goal (MDG) number 1 of 'halving, by 2015, the number of hungry people and those living on less than a dollar a day.' GCP's efforts to produce superior crop varieties that can be used by farmers offer the potential to improve the food and nutritional security and the income of poor farming households. They also offer the prospect of more affordable food for poor consumers (GCP 2007).

The above mentioned features of GCP like international networking, sharing of knowledge and technology, upstream research with a clear goal with downstream development, delivery mechanisms and a strong connection with the development issues, will provide an appropriate research setting to make an exploratory study for the theoretical as well as empirical scholarship for the open source and commons along with its interconnection with the development issues pertaining to agricultural modernization and development for the developing world.

6 EXPECTED THEORETICAL CONTRIBUTIONS AND REVISIONS

6.1 Open source

The term open source has its origin in the software industry. During the 1990s the software developers find a difficulty in developing or modifying software particularly with the operating systems as the system code of those software were patented by a few companies. By patenting the system code of the operating systems the big software companies monopolise the software development and restricted others to use and re-use it, thus they maintained hegemony within the software industry. This over restriction in the availability of system codes were resulted into "free and open source software" (FOSS) movement. FOSS movement was widely documented and analysed by Raymond, Stallman and Weber (Raymond 1999; Stallman, Gay, and Lessig 2002; Weber 2004). The greatest example of the success of the FOSS can be seen in the development of Linux where the originator of the programme Linus Torvalds released the code of the programme under an open source license and depended on the hackers to contribute their time and expertise to its elaboration, improvement and modification.

So open source doesn't mean that the resource is free for everyone nor it is based on the premise that everything should be a free resource for everyone. In contrast to that *it is a sharing arrangement* where the provision is made under a licence so that

people can able to improve, modify and develop it with the obligation to share the modified version through the same license through which the resource was obtained. This kind of open source licensing prevents the appropriation of the resource by companies which in turn can be subjected for a proprietary right for commercial use. Eventually the resource becomes an open source commons but a *protected commons* that can only be used by those who are willing to share it.

6.2 Commons

The term commons generally refers to a resource that is shared by a group of people. In a commons the resource can be at regional level (a playground), national level (roads, rivers) or at the global level (the atmosphere, knowledge). Sometimes the commons have a distinct boundary like the playground, it may be a trans - boundary property like the Nile River or it may not have a clear cut boundary like the atmosphere or knowledge. But the unifying thread in all the commons is that it is shared by many actors and needs a collective action to manage. The interesting aspect of natural resource commons like water bodies, forests is that it has a long history along with a large number of interdisciplinary literatures in contrast to knowledge as a commons which has had a brief literature written over within the last decade. In a word commons conveys the idea of shared ownership, participation and responsibility. The paucity of available literature on knowledge as a commons constituted another major motivation for this project as it aims to contribute to the debate on the feasibility, applicability and possibility of knowledge commons in plant science domain and its potential in translating the knowledge commons into concrete development. Throughout this research the term knowledge commons or scientific commons will be used as synonymous with the term ‘commons’.

A number of authors have already started analysing the open source and commons in biological sciences and they also motivated by the success of the FOSS movement in software looking forward to place a solution to the stringent proprietary regimes (Deibel 2006; Hope 2008; Rai and Boyle 2007; Srinivas 2002). However, the most successful initiative in open source and commons in biology can be found with the CAMBIA in developing the BiOS (Biological Open Source) where a lot of research tools of genetic engineering was made freely available for innovation for marginalized farming communities (Kloppenburg 2010).

As mentioned- this research project will investigate the Generation Challenge Programme (GCP) of the Consultative Group of International Agricultural Research (CGIAR) which itself is an example of upstream commons with a clear cut focus on downstream development issues.

6.3 Understanding knowledge as commons

Understanding knowledge as commons is relatively a new phenomenon in the academic discourses. Before we start operationalize the term ‘knowledge as commons’ it is important to understand what knowledge means for this research. Knowledge refers to all intelligible ideas, information, and data in whatever form it is expressed or obtained. According to Davenport and Prusak, knowledge derives from information as information derives from data (Davenport and Prusak 2000). Machlup (Machlup 1983) expresses that data are the raw bits of information, information being organised data and knowledge being the assimilation of the information and understanding of how to use it. In this research knowledge is something which is

gained through experience or by study. It may be indigenous, scientific, scholarly, non-academic, or mere experience. According to some other researchers, knowledge has a dual function: as a commodity and as a constructive force of society (Braman 1989; Reichman and Franklin 1999). This dual functionality of knowledge makes it more complex while analysing. Acquiring and discovering knowledge is both a social process and a deeply personal process (Polanyi 1958).

Before 1995, there were few scholars who saw the connection between knowledge with commons. But after 1995, people started noticing problems like congestion, free riding, conflict, overuse and pollution with the digital information and knowledge management portals. These problems are long been associated and identified with the common pool resources like forest, water bodies, and fisheries. This was the time when a number of scholars found the concept of commons is useful to *conceptualise new dilemmas* they were observing with the rise and distribution of digital information. Although there is a similarity of knowledge commons with the natural resources commons (forest, fishery, water bodies) in terms of shared management or a resource which is jointly owned. However, knowledge commons are non-subtractive. That means, knowledge commons is non-depleting. Most interestingly, most of the interdisciplinary work on knowledge commons is routed in two intellectual histories: the history of enclosure and the history of openness and inclusiveness, that is, democracy and freedom (Hess and Ostrom 2007).

James Boyle (Boyle 2003) in his 'second enclosure movement' featured the enclosure of the intangible commons of the mind through rapidly expanding intellectual property rights. The occurrence of enclosure created apprehension in many academic scholars regarding the growing privatisation, commodification and withdrawal of information that used to be accessible or that will never be available. The trend of enclosure is based on the ability of new technologies to capture resources that were previously un-owned, unmanaged and thus, unprotected. This is the case with knowledge and information. The case of distributed digital technologies is particularly complex and problematic as many stakeholders seek to renegotiate their interests in the new digital environment. Currently there are a vast array of enclosure threats to information and knowledge including computer code as law (Lessig 1999) and new intellectual property legislation (DMCA, TRIPS, copyright act) that undermine free access to public, scientific and government information. The second idea of commons is most often referred to *shared spaces* that allow for free speech and democratic process. Benkler (Benkler 2004) termed it as commons based production. It is the narrative of digital interoperability, open science, collaboration and scholarly networks, voluntary associations and collective actions. This type of commons underscores the importance of shared spaces and shared knowledge in fostering viable democratic societies.

In this research, these two ideas will be considered in order to analyse the knowledge production through generation challenge programme as a means to overcome the strict intellectual property enclosure and secondly, a case study will be prepared to show how this open access provides an opportunity for more democratic and inclusive agricultural technology development.

6.4 Governance of knowledge commons

Governance of commons is one of the very important problem researchers' faces. There are two distinct arenas of commons: commons as a resource or resource system which often termed as *common pool resources* and *common property* which is a legal regime, a jointly owned legal set of rights (Bromley 1986; Ciriacy-Wantrup and Bishop 1975). This research will include the term commons to indicate the complexity and variability of knowledge and information as resources. Knowledge commons consists of multiple types of goods and regimes and still have many characteristics of a commons.

Problems regarding the use, governance, and sustainability of any commons are due to the human behaviour that leads to social dilemmas such as competition for use, free riding and over harvesting. The governance of knowledge commons is subjected to the threats of commodification or enclosure, pollution and degradation, and non-sustainability. However, ideas of governance of knowledge commons can be bought from the traditional commons as voluminous literature is available on the governance of common pool resources. Borrowing from that literature, three essential points are inevitably crucial for good governance of knowledge commons. These are: *equity, efficiency* and *sustainability*. Equity refers to issues of just or equal appropriation form and contribution to the maintenance of a resource. Efficiency deals with the optimal production, management, and use of the resource. Sustainability looks at the outcome over the long term (Hess and Ostrom 2007).

The above mentioned conceptualisation of governance of commons will be applied to analyse the generation challenge programme as it aims to provide knowledge and new technologies for the development of resource poor farmers. Global revolution in digital information era along with the sharing mechanism with the World Wide Web will provide infinite amount of knowledge which we owe to the future generations. The challenge of this research is to indicate possible pathways to keep this knowledge open for development.

6.5 International development and agriculture

The connection between agriculture and international development is not coincidental but more rational and this has been identified long back (Hirschman 1958; Johnson 1993; Johnston and Mellor 1961). Agriculture was seen as an important force to initiate development through a modernisation and industrialization of agriculture (Adelman 2001). According to many authors, agricultural modernization is widely acknowledged to play a pivotal role for economic development in the less developed countries (Diao et al. 2007; Dorward et al. 2004; Thirtle et al. 2001). Within the modernisation process the focus often goes to plant breeding technologies and more precisely to the development of new seeds (Vroom 2009)[6].

Nonetheless hitherto agricultural modernisation played a role during the Asian green revolution to increase productivity and in transforming the farmers into entrepreneur. However, in our approach we are very critical about the means of modernisation and industrialisation of agriculture for its non-appropriateness to the location specific

[6] Those who are interested in the various reasons for giving importance to plant breeding may refer to (Vroom 2009).

needs both social and ecological (Vroom, Ruivenkamp, and Jongerden 2007). Moreover, the technology which is used to develop the seed is having a political agenda in it. Developed seeds are having terminator technologies inside it and the farmers cannot replant or reproduce it. At the same time the usage of these developed seeds need extra synthetic fertiliser which again is supplied by the private company. As a result the farmer who used to replant his seeds now have to depend on the corporate companies for the seeds and thus the farmer became more vulnerable to the risks that are associated with the international market mechanisms (Kloppenburg 1988; Ruivenkamp 1989). Secondly, the idea of modernisation is that one highly developed seed can perform very well in all the regions of the world as a result the local agricultural practices and farming systems have largely been replaced by a relatively homogeneous farming system (Kloppenburg 1988; Ruivenkamp 2005; Scott 1998; van der Ploeg 2008). It may work in some specific regions by increasing productivity but it has a very limited role in the areas which is characterised by highly diversified and locally adapted farming practices (Richards et al. 2009). Thirdly, modernisation is a disconnection process between the agriculture and local environment, and agriculture and food production (Ruivenkamp 2005). In view of this above discussions, the agricultural modernization appears as unsustainable and destructing force for the local knowledge, local environment etc. Hobsbawm termed it as a *death of peasantry* (Hobsbawm 1994). This on other hand caused to call for reconnecting nature, people and land for sustainable agriculture (Pretty 2002), call for an attention for modern peasant based production (van der Ploeg 2008), and linking up formal with informal seed systems (Louwaars 2007).

In the process of reconnecting agriculture with the local environment we envisage three process which according to us are very important: endogenous development, tailoring technologies, and bottom-up innovation. Ploeg and Long introduced the idea of endogenous development in which the aim is to elaborate the potentialities of local knowledge and natural and social resources with several stakeholders. The technological development that arises from such an approach could be regarded as *born from within* rather than a scientific model imposed from outside (Van der Ploeg and Long 1994). Another way of developing appropriate technology is tailoring of new technologies such as genomics to the potentialities of local agriculture and food production. This would involve both *transfers of technology* as well as *endogenizing* the technology (Vroom, Ruivenkamp, and Jongerden 2007). The issues of bottom-up innovation is described in the following paragraph. But the question is how to realize the endogenous technology or tailoring technology? In this research we assume that open source and commons can play a role for offering possibilities to tailor technologies according to location specific needs.

In this research we will try to investigate how improved varieties can be developed through the advanced plant breeding technologies that are being made available by the GCP for less developed countries. Further, it will be investigated how this sharing mechanism of knowledge work actually, as well as what possibilities are there to incorporate local knowledge by using advanced technologies? By reflecting to these issues conclusions will be drawn on the open source and commons paradigm in regard to development.

6.6 Innovation

In this research we define innovation as anything new that is successfully introduced into an economic or social process (Spielman et al. 2008). In regard to agricultural development there are two types of innovation trajectories: top-down and bottom-up. Bottom-up innovation trajectories are closely related to local needs and circumstances while the top-down which is often known as linear vision where innovation results from the creation of knowledge through basic scientific research, followed by strategic, applied, and adaptive research and ultimately to technology development, dissemination and adoption. For our research neither the bottom-up nor the top-down can completely fulfil our research as GCP has both the upstream research as well as the bottom-up developments. This is the reason we are focussing towards the complementarity of these two approaches and that is known as Systems of Innovation Framework (Vroom 2010). System of Innovation Framework emerged due to the failure of linear vision of innovation to explain innovations. The system of innovation framework envisages innovation in a more systematic, interactive and evolutionary way, whereby networks of organisations together with institutions and policies that affect their innovative behaviour and performance, bring new products and processes into economic and social use (Hall 2005). Some key features of System of Innovation Framework are as follows.

First, new inputs or technologies should not be viewed as innovations themselves, but as embedded information that agents can use in different ways, including ways that are different from what they were created for (Metcalfe 1999). Second, innovations depend on the ability of agents to learn on their ability to gather information and use it creatively in response to market opportunities or other social needs (Lundvall 1999; Organisation for Economic Cooperation and Development (OECD) 1999). Third, innovation depends on the organisational cultures within which innovation occurs, or the set of basic assumptions that are invented, discovered, or developed by a group in the process of learning how to deal with external adaptation and internal integration (Schein 1984). Fourth, innovation depends on the ability of agents to interact and exchange information and knowledge. Interactions can occur at any stage in the process of producing, exchanging or applying knowledge through various types of networks, linkages, and interventions (Fagerberg 2005; Nelson and Rosenberg 1993).

In a nutshell, the key elements of innovation system depend on three points: strengthening individual and collective capabilities to innovate, improving organisational cultures and behaviours in support of such capabilities and fostering networks and linkages with other innovation agents (Cohen and Levinthal 1990).

Successful technology development is a very complex process (Biggs and Smith 1998). It often results from the nuances of personal, professional and institutional relationships that change and evolve (often rapidly) over time. These changes take place in response to new technological needs as well as political and economic circumstances. Furthermore it is these nuances often only identifiable through detailed case histories that are so difficult capture in the neoclassical analysis of innovation process and the relationship between research investments and impacts on the poor. Partnership arrangements of various types are important issues to view innovation and technology development. In the subsequent section, we will discuss the issues regarding the research design that is envisaged for this project.

7 RESEARCH DESIGN

The research will start with an extensive literature review on open source and commons discourse pertaining to plant science, and agricultural development. This literature will eventually lead to development of a theoretical framework of understanding the open source and commons within the contemporary debates over open access, IPR, farmer's rights, breeder's right, and several enclosure regimes of plant genetic resources. This will be followed by introducing the GCP as a potential open source and commons programme where the research issues will be identified and the possible ways to explore the GCP will be illustrated.

In the next part of the research, a technographic analysis will be made on GCP. Technography is a useful methodology to observe, describe and locate the technical fact within socio-economic contexts (Sigaut 1994). Richards (2001) suggests that *technography* is a useful label to emphasize the importance of capturing the full complexity of social and biological worlds and to achieve contextual understanding of agro-ecosystem development. Steve Woolgar (1996:88) defines technography as the social –scientific study of technical setting in which , as with the ethnographic method, a main focus is to determine how distinctions- between e.g. technology producer, consumer and user- are created and sustained, as well as determining what effect they have on design and development. Zannou (2006) and Kassawiki (2008) describe the approach in terms of an attempt to map the actors, processes and client groups in such a way as to enable analysts to see beyond the technology itself, to the problems technological applications are supposed to solve and the parties and interests that are being mobilized in arriving at solutions (Kissawike 2008). This technographic approach will be applied to analyse and deconstruct the stories of GCP as an open source and commons programme.

Moreover the interrelationships between open source and commons will be elaborated with the help of the case studies method. Case study is a qualitative research strategy oriented towards in an in-depth understanding of one or various phenomena. This approach takes into consideration life stories allowing the researcher to capture various on-going among people and their lives. Case study is an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between phenomenon and context are not clearly evident (Yin 2003).Several case studies will be identified within the GCP's functioning within several locations and several crops. Interviews, participant observations, studying the policy documents will be main means of data collection. Data will be then analysed with respect to the theoretical framework and with respect to the various research questions. Analysed data will be presented as case study from which logical interpretation will be made in the light of the main research question of the study. This research will be purely qualitative as we want to understand the discourse of the open source and commons and its interrelationship with the developmental issues so it is not possible to do that through quantitative analysis.

8 CONCLUDING REMARKS

In this article we discussed our new research agenda on *open source, commons* and *its relationship with the international developmental issues pertaining to the agricultural development* and the opportunities for open source and commons to stimulate endogenous agricultural developments. In this concluding section we

would like to summarize the discussions and try to answer the question that we have asked at the very beginning of this paper: why it is important to have a research programme on open source commons and development within life sciences domain?

This paper discussed four main issues: the emergence of open source and commons in life-sciences, international development and agricultural modernisation, endogenous development, and presumed connectedness of open source commons with endogenous agricultural development. The central point of these four issues is how agricultural technology can be made more endogenous or can be tailored to location specific needs. It is assumed that open source and commons can play a very pivotal role in achieving so. This implies that we need to investigate two different research lines: governance of open source and commons, and development of technologies that are more tailored towards local needs. GCP is proposed as a research phenomenon as it is an international sharing network along with a concrete focus on downstream developments, which is why a systematic scientific exploration of GCP will help us to reflect the above mentioned research lines. Four provisional concluding remarks can be made.

Firstly, open source and commons are relatively new concepts within the academic discourses as a result there is a paucity of scientific literature on this issue, so this research is quite logical at this point of time as it aims to fulfil this gap. Secondly, according to many contemporary researcher and other intellectuals this new trend of sharing mechanism of knowledge production has the potential to offer a solution to: the problems of stringent IPR regimes, can blur the designer-user dichotomy, encourage the user innovation, so on and so forth. How far these hypothesis can be proved true and in what conditions is another motivation of this project. Thirdly, a lot of researchers are doing research on open source and commons paradigm in life sciences but they are confined to the production of knowledge by sharing arrangement and their ambition is limited to investigate the dynamics of this new knowledge production where as in our research apart from investigating the dynamics of knowledge production we are interested to go beyond to see the eventuality of the commonly produced knowledge as well as the governance of the common consortium which produced the common knowledge. It is expected that by reflecting these two issues we will contribute to answer the question ‘how commonly produced knowledge remain common?’ Finally, the possibilities of international development by encouraging innovation and farmers participation through the open source and commons are other interesting issues and motivation for this project.

9 REFERENCE

Adelman, I. 2001. Fallacies in development theory and their implications for policy. In *Frontiers of development economics: The future in perspective*, edited by G. M. Meier and J. E. Stiglitz. New York: World Bank.

Aoki, K. 2009. "Free seeds, not free beer": participatory plant breeding, open source seeds, and acknowledging user innovation in agriculture. *Fordham Law Review* 77 (5):2275-2310.

Atkinson, R. C., R. N. Beachy, G. Conway, F. A. Cordova, M. A. Fox, K. A. Holbrook, D. F. Klessig, R. L. McCormick, P. M. McPherson, H. R. Rawlings Iii, R. Rapson, L. N. Vanderhoef, J. D. Wiley, and C. E. Young. 2003. Public sector collaboration for agricultural IP management. *Science* 301 (5630):174-175.

Benkler, Y. 2004. Commons-based strategies and the problems of patents. *Science* 305 (5687):1110-1111.

Biggs, S., and G. Smith. 1998. Beyond methodologies: Coalition-building for participatory technology development. *World Development* 26 (2):239-248.

Blakeney, M. 2009. *Intellectual property rights and food security*. Wallingford [etc.]: CABI.

Boyle, James. 2003. The Second Enclosure movement and the Construction of the Public Domain. *Law and Contemporary Problems* 66 (1-2):33-74.

Braman, S. 1989. Defining information:: An approach for policymakers. *Telecommunications Policy* 13 (3):233-242.

Bromley, DW. 1986. Closing comments at the conference on common property resource management.

Brush, S. B. 2004. *Farmers' bounty : locating crop diversity in the contemporary world*, *Yale agrarian studies series*. New Haven: Yale University Press.

CIMMYT, IPGRI, and IRRI. 2003. Unlocking Genetic Diversity in Crops for the Resource- Poor: A proposal for a CGIAR Challenge Programme.

Ciriacy-Wantrup, SV, and RC Bishop. 1975. Common Property' as a Concept in Natural Resources Policy. *Natural Resources Journal* 15.

Cohen, WM, and DA Levinthal. 1990. Absorptive capacity: a new perspective on learning and innovation. *Administrative science quarterly* 35 (1).

Davenport, TH, and L Prusak. 2000. *Working knowledge: How organizations manage what they know*: Harvard Business Press.

Deibel, E. 2006. Common Genomes: Open source in biotechnology and the return of common property. *Tailoring Biotechnologies* 2 (2):49-84.

Diao, Xinshen, P.B.R. Hazell, Danielle Resnick, and James Thurlow. 2007. The role of agriculture in development. Implication for Sub-Saharan Africa. Washington D.C.: International Food Policy Research Institute.

Dorward, A., J. Kydd, J. Morrison, and I. Urey. 2004. A policy agenda for pro-poor agricultural growth. *World Development* 32 (1):73-89.

Dutfield, G. 2003. *Intellectual property rights and the life science industries : a twentieth century history*, *Globalization and law*. Aldershot [etc.]: Ashgate.

Fagerberg, J. 2005. Innovation: a guide to the literature. *The Oxford Handbook of Innovation. Oxford University Press, New York, S*:1-26.

Fowler, C. 2000. Plant Patent Act of 1930: A Sociological History of Its Creation, The. *Journal of the Patent and Trademark Office Society* 82 (9):621-644.

GCP. 2007. Generation Challenge Programme Strategic Framework.

GCP. *Introducing GCP*. CGIAR Generation Challenge Programme 2010. Available from http://www.generationcp.org/UserFiles2/File/Comms-docs/Brochures/GCP-brochure_4pgs.pdf.

GCP. *Phase 1 to Phase 2*. CGIAR Generation Challenge Programme 2010. Available from http://www.generationcp.org/UserFiles2/File/Comms-docs/Brochures/LookingBack.pdf.

Graff, G, and D Zilberman. 2005. Towards an intellectual property clearinghouse for agricultural biotechnology. *Agricultural Biodiversity and Biotechnology in Economic Development*:387-403.

Graff, G., and D. Zilberman. 2001. An intellectual property clearinghouse for agricultural biotechnology. *Nature Biotechnology* 19 (12):1179-1180.

Hall, A. 2005. Capacity development for agricultural biotechnology in developing countries: an innovation systems view of what it is and how to develop it. *Journal of International Development* 17 (5):611-630.

Heller, M. A., and R. S. Eisenberg. 1998. Can patents deter innovation? The anticommons in biomedical research. *Science* 280 (5364):698-701.

Hess, C., and E. Ostrom. 2007. Introduction: An Overview of the Knowledge Commons. In *Understanding Knowledge as a Commons: From Theory to Practice*, edited by C. Hess and E. Ostrom. Cambridge, Massachusetts: The MIT Press.

Hirschman, A.O. 1958. *The strategy of economic development*. New haven, Connecticut: Yale University Press.

Hobsbawm, E. 1994. *Age of extremes : the short twentieth century 1914 - 1991*. London: Joseph.

Hope, J. 2008. *Biobazaar : the open source revolution and biotechnology*. Cambridge, MA [etc.]: Harvard University Press.

Hope, Janet Elizabeth. 2004. Open Source Biotechnology, Faculty of Law, Research School of Social Sciences The Australian National University.

Johnson, DG. 1993. Role of agriculture in economic development revisited. *Agricultural economics* 8 (4):421-434.

Johnston, BF, and JW Mellor. 1961. The role of agriculture in economic development. *The American Economic Review* 51 (4):566-593.

Kissawike, K. 2008. Irrigation-based livelihood challenges and opportunities : a gendered technography of irrigation development intervention in the Lower Moshi irrigation scheme in Tanzania. Proefschrift Wageningen Met lit. opg. - Met samenvatting in het Engels en Nederlands, s.n.], [S.l.

Kloppenburg, J. 2010. Seed Sovereignty: the promise of Open Source Biology. In *Food Sovereignty: Theory, Praxis, and power*, edited by A. Desmarais and W. Hannah K: Fernwood Publishing.

Kloppenburg, J. R. 1988. *First the seed : the political economy of plant biotechnology 1492-2000*. Cambridge [etc.]: Cambridge University Press.

Kloppenburg, J. R. 2004. *First the seed : the political economy of plant biotechnology, 1492-2000*, *Science and technology in society*. Madison, WI: University of Wisconsin Press.

Lessig, L. 1999. Code and the Commons. Paper read at Conference on Media Convergence, at New York.

Louwaars, N. 2007. Seeds of confusion : the impact of policies on seed systems. Proefschrift Wageningen Met lit. opg. - Met samenvatting in het Engels en Nederlands, s.n.], [S.l.

Lundvall, BA. 1999. Technology policy in the learning economy. In *Innovation policy in a global economy*, edited by D. Archibugi, J. Howells and J. Michie. Cambridge, UK: Cambridge University Press.

Machlup, F. 1983. Semantic quirks in studies of information. In *The study of information: Interdisciplinary messages*, edited by F. Machlup and U. Mansfield. New York: Wiley.

Mazzoleni, R, and RR Nelson. 1998. Economic Theories about the Benefits and Costs of Patents. *Journal of Economic Issues* 32 (4):1031-1033.

Metcalfe, JS. 1999. Science, technology and innovation policy in developing economies. Paper read at Enterprise Competitiveness and Public Policies, at Barbados.

Nelson, RR, and N Rosenberg. 1993. Technical innovation and national systems. In *National innovation systems: A comparative analysis*, edited by R. Nelson. New York: Oxford University Press.

Nottenburg, C, PG Pardey, and BD Wright. 2002. Accessing other people's technology for non–profit research. *Australian Journal of Agricultural and Resource Economics* 46 (3):289-416.

Organisation for Economic Cooperation and Development (OECD). 1999. Managing national Innovation System. Paris: OECD.

Polanyi, M. 1958. *Personal Knowledge: Towards a Post-Critical Philosophy*. Chicago: The University of Chicago Press.

Pretty, J. 2002. Reconnecting People, Land and Nature. *Earthscan. UK*.

Rai, A, and J Boyle. 2007. Synthetic biology: caught between property rights, the public domain, and the commons. *PLoS Biol* 5 (3):e58.

Raymond, Eric S. 1999. *The cathedral and the bazaar : musings on Linux and open source by an accidental revolutionary / Eric S. Raymond ; with a foreword by Bob Young*. Sebastopol, CA :: O'Reilly.

Reichman, JH, and JA Franklin. 1999. Privately legislated intellectual property rights: Reconciling freedom of contract with public good uses of information. *University of Pennsylvania Law Review* 147 (4):875-970.

Richards, P. 2001. Reviving the green revolution: a technographic approach. In *Resonances and dissonances in development: actors, networks and cultural reportoires*, edited by P. Hebinck and G. Verschoor. Assen: Royal Van Gorcum.

Richards, P, M De Bruin-Hoekzema, SG Hughes, C Kudadjie-Freeman, S Offei, P Struik, and A Zannou. 2009. Seed systems for African food security: linking molecular genetic analysis and cultivator knowledge in West Africa. *International journal of technology management* 45 (1):196-214.

Ruivenkamp, G. 1989. De Invoering Van Biotechnologie in De Agro-Industriele Productieketen: De Overgang Naar Een Nieuwe Arbeidsorganisatie, Universiteit Van Amsterdam, Amsterdam.

Ruivenkamp, G, S Hisano, and J Jongerden. 2008. *Reconstructing Biotechnologies: Critical Social Analyses*: Wageningen Academic Publishers.

Ruivenkamp, G. 2005. Tailor-made biotechnologies: Between bio-power and sub-politics. *Tailoring Biotechnologies* 1 (1):11-33.

Ruivenkamp, G. 2008. *Biotechnology in development : experiences from the south*. Wageningen: Wageningen Academic Publishers.

Ruivenkamp, G., and J. Jongerden. 2010. OPEN SOURCE AND COMMONS IN DEVELOPMENT. Paper read at Innovation and Sustainable Development in Agriculture and Food (ISDA), at Montpellier, France.

Salazar, R., N. P. Louwaars, and B. Visser. 2007. Protecting Farmers' New Varieties: New Approaches to Rights on Collective Innovations in Plant Genetic Resources. *World Development* 35 (9):1515-1528.

Schein, Edgar H. 1984. COMING TO A NEW AWARENESS OF ORGANIZATIONAL CULTURE. *Sloan management review* 25 (2):3-16.

Scott, J. C. 1998. *Seeing like a state : how certain schemes to improve the human condition have failed*, *Yale ISPS series / The Institution for Social and Policy Studies at Yale University*. New Haven [etc.]: Yale University Press.

Sigaut, F. 1994. Companion Encyclopedia of Anthropology. In *Technology*, edited by T. Ingold. London: Routledge.

Spielman, D. J., J. Ekboir, K. Davis, and C. M. O. Ochieng. 2008. An innovation systems perspective on strengthening agricultural education and training in sub-Saharan Africa. *Agricultural Systems* 98 (1):1-9.

Srinivas, K. 2002. The Case for BioLinuxes: And Other Pro-Commons Innovations. *Sarai Reader 2002: The Cities of Everyday Life*:321–8.

Stallman, RM, J Gay, and L Lessig. 2002. *Free software, free society*: Gnu Press Boston.

Thirtle, C, X Irz, L Lin, V McKenzie-Hill, and S Wiggins. 2001. Relationship between changes in agricultural productivity and the incidence of poverty in developing countries. *DFID, London: Imperial College*.

Thompson, C. B. 2004. International law of the sea/seed: Public domain versus private commodity. *Natural Resources Journal* 44 (3):841-866.

van der Ploeg, J. D. 2008. *The new peasantries : struggles for autonomy and sustainability in an era of empire and globalization*. London [etc.]: Earthscan.

Van der Ploeg, JD, and A Long. 1994. Endogenous Development: Practices and Perspectives. In *Born from within: practice and perspectives of endogenous rural development*, edited by J. Van der Ploeg and A. Long: Uitgeverij Van Gorcum.

Vroom, V. 2010. Linking upstream genomics research with downstream development objectives: The challenge of the Generation Challenge programme. *International Journal of Technology and Development Studies* 1 (1):77-98.

Vroom, W. 2009. *Reflexive Biotechnology Development: Studying Plant Breeding Technologies and Genomics for Agriculture in the Developing World*: Wageningen Academic Publishers.

Vroom, W, G Ruivenkamp, and J Jongerden. 2007. Articulating alternatives: Biotechnology and genomics development within a critical constructivist framework. *Graduate Journal of Social Science* 4 (1):11-33.

Weber, Steve. 2004. *The success of open source / Steven Weber*. Cambridge, MA :: Harvard University Press.

Yin, R. K. 2003. *Case study research : design and methods*, *Applied social research methods series;vol. 5*. Thousand Oaks, CA [etc.]: Sage.

Zannou, A. 2006. *Socio-economic, agronomic and molecular analysis of yam and cowpea diversity in the Guinea-Sudan transition zone of Benin*, *Tropical resource management papers;no. 80*. [Wageningen: Wageningen University and Research Centre].