Working Party on Agricultural Policies and Markets

Workshop on innovations in food and agriculture system: Policies to foster productive and sustainable solutions, 25-26 February 2016: Summary report

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The summary report of the Workshop on innovations in food and agriculture system is presented for INFORMATION at the 68th session of the Working Party on Agricultural Policies and Markets under Item 8 of the Draft Agenda.

Contact: Catherine Moreddu (catherine.moreddu@oecd.org)
Note by the Secretariat

This room document contains the summary report of the Workshop on innovations in food and agriculture system held on 25 (pm)-26 February 2016 in Paris. It has been prepared by Lihan Wei and reviewed by workshop speakers. The agenda of the workshop in included in an annex. Additional material from the workshop, including list of participants, presentations and background information, can be accessed at: http://www.oecd.org/tad/events/workshop-innovations-food-agriculture-february-2016.htm

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WORKSHOP ON INNOVATIONS IN FOOD AND AGRICULTURE SYSTEM: POLICIES TO FOSTER PRODUCTIVE AND SUSTAINABLE SOLUTIONS, 25-26 FEBRUARY 2016: SUMMARY REPORT

Context and structure

1. Innovation in the food and agricultural system is a key to sustain the productivity growth needed to meet the growing and more diverse demand for food, feed, fuel and fibre at global level, while preserving environmental resources, and adapting to and mitigating climate change. New developments in science offer promising applications in primary agriculture, downstream industries in food processing and non-food uses of biomass. Moreover, given the global nature of these challenges, international cooperation in the development, dissemination and application of appropriate science, technologies, techniques and related regulatory frameworks will bring global benefits.

2. The Workshop on innovations in food and agriculture system: Policies to foster productive and sustainable solutions took place on 25-26 February 2016 in Paris. Organised jointly by the Trade and Agriculture Directorate (TAD) and the Directorate for Science, Technology and Innovation (STI) of the OECD, over 80 delegates and experts met to discuss how scientific, technological, and farm practice innovation can improve productivity and sustainability in the food and agricultural sector, with a focus on international collaboration.

3. The meeting was organised around three main sessions: Innovations in the bioeconomy; Big data generated by Information and Communication Technology (ICT); and International cooperation for innovation. Following each session, panel and general discussions provided opportunities for further insight and understanding. The meeting concluded with overall summary remarks including possible implications for future OECD work (see Agenda in the annex).

4. The agenda, summary record, list of participants and presentations will be available on-line at: http://www.oecd.org/tad/agricultural-policies/innovation-food-agriculture.htm.

Session 1. Innovations in the bioeconomy

5. The bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. Biotechnology and the biorefinery concept are considered essential components. Innovations in these areas include new gene modification techniques, and the development of processes using a wider range of biological resources to obtain new products. Developments in the bioeconomy have numerous impacts on the food and agriculture sector: they can supply seeds improving natural resource efficiency producing commodities better adapted to consumers' and industry's demand, but they also increase competition for land and other natural resource use between food and other biomass usage. Countries need to develop policy strategies to ensure a sustainable development of the bioeconomy and need to progressively adapt regulations to new developments.

6. James Philp, from the OECD's Science, Technology and Innovation Directorate, provided an overview on genomics and the bioeconomy highlighting the range and variety of strategic initiatives, approaches and priorities across countries. As a nascent field, terminologies and contexts for the bioeconomy differ across countries reflecting various approaches and priorities taken by countries. The EU Bioeconomy Strategy (2012) has set precedent for other countries by building on three pillars – investment in science and skills, better policies and partnership, and boosting competitiveness of the bioeconomy. He highlighted how biotechnology is already contributing to food security through genomics projects in beef, dairy, chicken, aquaculture, crops and even wild fisheries. As an example, five major US crops have at

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least 90% adoption of GM varieties. A longer term goal is to produce cereal crops that fix nitrogen through techniques of synthetic biology. Current projects underway in countries illustrate the potential of the bioeconomy and the increasing relevance of bio-based, transferring from a fossil fuel based economy to a biomass based economy, as an issue for long-term consideration. The bio-based economy holds potential for significant job creation. The recent Global Bioeconomy Summit provided some indications for policy considerations through a consensus food-first approach to policy (i.e. the nature and importance of global food security) to drive policy relevance.

7. Erik Mathijs, a professor of Agricultural and Resource Economics at the Department of Earth and Environmental Sciences of the University of Leuven, presented the results of a foresight exercise entitled - Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe. For the 4th SCAR (EU’s Standing Committee on Agricultural Research) exercise, the expert group was tasked with exploring possible future scenarios based on anticipated global issues and then developing responses for the European Bioeconomy Strategy. The guiding issues of the exercise included the role of the bioeconomy to improve food security and how innovation can be a key to sustainable progress while maintaining competitiveness. Three scenarios in the foresight exercise were outlined: bio-modesty including modest growth; bio-boom with high growth in demand and supply; and bio-scarcity with high demand growth and low supply. A food first approach would provide a contrast to market intervention. Through ICT and genomic driven innovation, it may be possible to increase opportunities for small farmers to benefit from the bioeconomy through the right policy approach. Future policy frameworks will need coherence and integration (both horizontal and vertical) in order to harness the potential of the bioeconomy. Rules for good governance will be crucial at the early stages to properly influence the development of the bioeconomy with a view towards inclusiveness.

8. Pierre-Alain Schieb presented a biorefinery case study from Champagne, France, a region that has been targeted for smart specialisation investment. Biorefineries can provide a viable alternative to fossil fuels and are a key example of productivity and sustainability from the bioeconomy. The Bazancourt-Pomacle biorefinery has the capacity to transform 2 million tonnes of sugar beet and 1 million tonnes of wheat into bioethanol. While oil refineries are located on the sea close to pipelines, biorefineries can be built and operated in the regions producing oil seeds, corn or wheat, thereby boosting rural economies while reducing transportation costs. Biorefineries involve farmers and cooperatives and thus are bottom-up projects rather than top-down. Historically, biorefinery development has been achieved through the incremental actions of farmers reacting to markets. Currently, the projects represent an innovation platform demonstrated by proof of concept with subsequent scaling up of research and development (R&D). As seen in the case study, partnerships in innovation for the bioeconomy will need to occur at the local, subnational, national and international levels. Aligning the right stakeholders is a key element for cooperation in innovation in the bioeconomy. Vertical partnerships and/or horizontal joint ventures (if not barred by anti-trust laws) could be helpful as a de-risking strategy.

9. Robert Manurung, from Institut Teknologi Bandung, presented the bioeconomy in the Grand Strategy of Indonesian Agricultural Development, providing a view from an emerging economy. In Indonesia, the bioeconomy has great potential with two-thirds of global biodiversity concentrated in tropical climates and as a national strategy for sustainable and inclusive agricultural development. Current projects include increasing growth and productivity for cassava and palm as well as harvesting algae for oil and protein. One percent of the Indonesian population owns 70% of the country’s wealth with a large gap between the rich and the poor. Opportunities for wealth in biomass exist for the wealthiest segment of the population, but in Indonesia where 40% of population work in agriculture but contribute only 15% of GDP, the development of a sustainable agricultural bioeconomy is viewed as way through and out of poverty towards greater productivity for rural populations, as outlined in the country’s bioeconomy strategy.
10. Steffi Friedrichs from the OECD’s Directorate for Science, Technology and Innovation presented the concept of gene editing providing a context for possible regulatory issues for agricultural innovations through the bioeconomy. Gene editing is a technique that edits DNA with a precision that has only recently been possible. The advances and the potential of the genomic technique have consequences for regulations. CRISPR, a specific gene editing technique, was presented as an illustration of potential regulatory issues based on its current and future applications. Current applications of CRISPR include mouse models for health and medicine research. The gene editing technique saves animals, time and money by creating viable mouse models for research needs rather than breeding the animals for the needed traits. Further potential includes the eradication of malaria-transmitting mosquito. In agriculture, CRISPR could create fast, targeted breeding plants with the ability to self-produce nitrogen – i.e. self-fertilising plant breeds. As a technique, CRISPR has faced difficulty in intellectual protection. Three patent requests were rejected in the United States as the USPTO (United States Patent and Trademark Office) did not find the processes described as patentable, but another is still pending while one patent has been granted. With over USD 11 million invested, CRISPR is a technique with wide application although discussion has begun around the potential risks posed by gene editing (e.g. poison creating plants, disease and defects in mammals) and the appropriate governance needed. The European Union is contemplating if gene-edited plants would be classified as genetically modified (GM). According to experts that have spoken out on the topic, gene editing produces some products that are GM and some that are not, depending on how the technique is used. The EU Food Safety Authority could classify all non-natural plants as GM, but the differences between breeding for characteristics and gene-editing are still being defined. There is a range of ethical issues in gene editing and the blurred boundaries make regulatory issues difficult.

11. Marcel Bruins, provided an overview on regulatory approaches to seeds including the OECD Seed Schemes, the International Union for the Protection of New Varieties of Plants (UPOV), the International Seed Testing Association (ISTA) and the International Seed Federation (ISF). Using the example of the tomato seed, he illustrated a need for greater alignment amongst the international players given the unique nature of international seed movement. Using the Global Hunger Index and contrasted to the members of the international community involved in seed regulation, the enabling environment for seed production is missing for countries with the highest hunger indices. The recently created World Seed Partnership provides an opportunity for increased cooperation. Seeds are subject to marketing thresholds that vary across countries rather than safety regulations. Given that new breeding techniques hold potential yet also come with unknown risks, the regulatory approach should follow the product that determines the safety rather than the process. Greater international coordination will be needed to harmonise regulations, mitigate unknown risks and meet global hunger challenges.

12. The first session concluded with panel and general discussions on highlighted points: the key market factors that drive the development of the bioeconomy; the adoption of innovations to meet productivity and sustainability challenges; and the alignment of regulation and policy to science and market development.

13. Bio-based fuels and gene editing provided examples of current R&D in the bioeconomy with implications for innovation in agriculture. Bio-based fuel R&D may need time to optimise the science and production process in order to become competitive in price with fossil fuels. Gene editing is an affordable and available technical process with potential applications in agriculture, yet regulatory issues still need to be better understood. Global issues including sustainability, fossil fuels, inclusiveness and food supply should serve as key drivers for the role of the bioeconomy in agricultural innovation. While market factors and incentives will drive the bioeconomy, policy makers will need to intentionally align the bioeconomy to the sustainability agenda.

14. Countries have varying priorities and applications for using biotechnologies. The use of biomass carries potential in meeting global agricultural productivity and sustainability challenges, but countries
have differing priorities and applications for its use. In order to address sustainability challenges, better definitions on biomass and understanding on its use and applications will be needed to measure impact on sustainability. Multilateral governance and public procurement strategies for R&D will help to establish the incentives and principles for biotechnology and innovations. Transparent, science-based regulatory approval processes will help to create trust and build public acceptance for innovations in the public sphere thereby creating market demand for innovation.

15. Consumer acceptance of bio-based innovations has of yet been hampered by a lack of trust and transparency in the research community. Government interventions through regulation and policy along with the involvement of civil society will be needed to promote and demonstrate societal benefit, safety and sustainability. Metrics for risk analysis and social benefit may be needed to quantify and understand risk. Assessments should be based upon good regulatory processes which should in turn be based upon transparent scientific evidence.

16. Biotechnology regulation is often about the process, as in the case of gene editing, rather than the product. Yet it is the product that has commercial value and tangible impact for productivity and sustainability challenges. Countries have a range of approaches to governance even in the midst of better understanding the bioeconomy. While some countries have taken a product evaluation approach, the European Union is currently debating whether all gene-editing products are GM or not. Regulation and policy could be better aligned to regulate biotechnology products through bodies such as the OECD that can facilitate collaboration, assist in consensus on definitions and provide policy advice. Based on the outcomes and experiences of previous workshops, an international biomass platform may be able to provide a forum for learning and dispute resolution.

Session 2. Big data generated by Information and Communication Technologies

17. Information and Communication Technologies (ICT) have multiple applications in food and agriculture. Internet-based simulation or forecasting tools, satellite imageries and connected tractors facilitate farmers’ decision-making and the implementation of precision agricultural practices. Data integration improves traceability along the supply chain and reduces information costs. Technologies that generate or make use of ‘big data’ are increasingly used in the sector, and new developments such as drones, could further improve the information base on which farmers make their decisions. At the level of policy implementation and monitoring, these technologies could reduce information asymmetries and improve the targeting of government programmes and reduce monitoring costs. The wider diffusion of the technologies, which offer promising applications, depends on whether the regulatory and policy environment addresses challenges in terms of privacy, organisation and interpretation of the information, and the costs and benefits of the associated tools, among others.

18. Krijn Poppe, from the agricultural economic research institute of Wageningen UR, presented opportunities for big data in food and agriculture. Modern farm equipment has now become data capturing equipment giving rise to opportunities for disruptive data and market change. The current 5th industrial revolution is providing the opportunity to revolutionise sub-sectors through precision farming and predictive maintenance of machines. In the food supply chain, data capture has the potential to manage the cycle from transport to sale. Food intake can be tracked and linked to healthy diets, wellness and exercise. Precision farming can provide growth at a rate of 12% per year. Big data in agriculture can lead to better monitoring (in the field and in animals), better opportunities for optimisation, reduced environmental impact and improved competence and governance. Business models provide opportunities to earn money with data. Industry has increased opportunities to create smart, connected products (e.g. tractor) that can lead to integrated product systems with further integration of systems of systems (e.g. irrigation systems connected to weather system connected to farm equipment system). There is a need for an Agri-Business Collaboration and Data Exchange Facility (ABCDEFs) to cope with technology changes by connecting the
different platforms of large multinationals with local small and medium enterprises (SMEs) so that the aggregate data will have greater value and impact in use. Examples of data exchange platforms in agriculture using differing forms of governance among multinationals include Google, Monsanto and non-governmental organisations (NGOs). With big data, there is a decreasing administrative burden for the small farmer to create value. Through FSpace (organised like Linux), an open source software that supports data exchange between apps, a farmer could potentially scan a pesticide package in the field, connect to weather forecasts and be provided with soil and weather specific instructions to his spraying machine (through the Internet of Things) for a context specific need. There are governance issues in the opportunities big data provides and to ensure data sharing between government and business, standardise data formats for sharing will be needed.

19. John Fulton, from Ohio State University, presented current practices, facts and realities regarding the management of big data in the United States. Currently, 80% of data collected on-farm is stored on local machines and not actionable as big data. Agriculture data has potential as a disruptive technology, but in the current state, high levels of investment may still be needed. In the United States, producers are sceptical and data warehousing is in silos with little integration. While the potential for the use of big data in agriculture is promising, current limitations need to be addressed. Data can be uploaded but not moved easily and data often cannot be recuperated by the farmer after upload. There are concerns for privacy (use), security, transparency, access and collection (e.g. for a modern tractor, only 30% of data is accessible by the owner of the tractor), portability (a farmers may need to interact with eight different companies, but may only wish to share data with three of these companies) and interoperability. Agricultural data management currently has little oversight with few rules thus leaving the area vulnerable to the private sector and market behaviour. Without good governance in big data management, the freedom to farm may be infringed. In the United States, investment in data is important where the leading internet companies have shared data Farmers lack confidence in the process and not fully understanding implications and benefits resist participation. Short term gains for the farmer may outweigh a long term approach that includes changes for big data use. Rural connectivity and issues of data quality remain barriers to uptake. Tensions exist between government actors including the Environmental Protection Agency (EPA) for policy and regulation. Recommendations for data management should include family farmer concerns on their ability to control profitability; access to rural broadband; lack of standard definitions around personal information (GPS tagging that is identifiable); data privacy and security principles.

20. John Crawford, from Rothamsted Research, presented on integrating the food chain with big data. Data, and particularly big data, must be worked with in order to become something useful. As it is currently becoming possible to connect and quantify in ways not previously available, the opportunity to collect data and optimise the food chain is unprecedented as well. Future global risks imply that the connectivity of big data may be essential to solving global issues. While data intrinsically may carry little value, through modelling and analytics data is made valuable. The UK Agri-tech Strategy has invested GBP180 million creating Centres of Excellence (COE). The first COE in Data Science, Modelling and Metrics of Sustainability is being designed as an industry-led initiative. Data are currently fragmented and collaboration will be necessary, but in sharing data risks will be inherent shared. Options for industry interaction with data platforms include: sharing industry data in a closed environment; sharing data in open think-tank environments; or data sharing among industry through a science ecosystem. Currently, the lack of clear understanding of the existing opportunities and scepticism of data sharing give rise to a need for an impartial intermediate. Opportunities and barriers exist to optimise and incentivise a food chain with multiple stakeholders. Better intellectual property models to facilitate sharing in open data are needed.

21. Julien Hardelin, from the OECD’s Trade and Agriculture Directorate, as discussant on the role of new data sources in greening growth, presented the context and interest of the work for the OECD within the framework of agricultural innovation and then presented three areas for discussion: policy implications
for regulation and competition including the risk of monopoly; good governance principles for leveraging big data for agricultural productivity and sustainability; and the role of consumer demand, policy and environmental regulation. General discussion that followed addressed the role of government in enabling the diffusion of big data application in food and agriculture.

22. Recognising the value and potential of data and seeing the risk of monopoly (e.g. the Silicon Valley technology platforms), government regulation or a hybrid governance model with government intervention will be needed to establish the rules for infrastructure and use in agricultural data platforms. Collaboration with industry, academia, civil society and the farmer in structuring the data platform will bring value-added and build trust. The role of government in the collaborative process will be important as there is a need for an impartial intermediate to safely and securely link big data for analytical use. Participation in the data platform will be eased through the creation, definition and subsequent use of common agro-metrics to ensure that data systems and reporting are aligned. Government may be able to create and enable better access to data through innovative procurement means (e.g. in the area of certification, maps, use of private information for government).

23. Big data has potential for productivity improvements at the farm level, although the capabilities and possibilities still need to be more fully understood. Considerations for the family farmer should take into account issues of privacy, data sharing and timely access to data in order for efficient and well-informed decision making. Along the food chain, big data brings potential efficiency gains and traceability for food safety. At the global level, there is potential, yet given the scope and the gaps in understanding, it is not yet known how big data will contribute to food security. While there are not enough studies currently measuring TFP (total factor productivity), better measures may be possible using big data and sector-level evidence. For big data in milk production, breeding data of offspring and grass feed conditions may predictive evidence for milk production. In the United States, big data has produced estimates in corn farming where farm level estimates using data analytics showed 5-10% increases in productivity.

24. Governments should take an active role in providing the rules and regulations for disruptive technologies. Regulation is essential so that the private sector or even any one leading business does not have the opportunity to establish infrastructure or market conditions alone. Governments can facilitate single source reporting and data access at the public level. Government can also act to fill the skills gap. In the United Kingdom, the Department of Governance and Skills has created opportunities for students interested in data sciences.

25. Andrew M. Davidson, from the Canadian Center for Agro-Climate, presented the use of Earth observation (EO) in meeting challenges and opportunities to support a competitive agricultural sector in Canada. Activities undertaken by Agriculture and Agri-Food Canada (AAFC) have used Earth observation to understand the diversity and extent of the agricultural landscape. Earth observation is the data gathering of a range of Earth’s systems via remote sensing technologies supplemented by Earth surveying techniques, encompassing the collection, analysis and presentation of data to better understand pre-planting to post-harvest conditions including production through research cycle. EO is a powerful tool that facilitates the development of a strong, competitive and innovative agri-food sector. As an example of what has been done with available data, in a space-based crop inventory, crop and non-crop land of all landscape types were mapped to better understand agricultural land use. Crop location patterns provide insight, with relevance to climate variation and changing market conditions. Previously, there were limitations to satellite and ground data, but currently the high volume of data (due to launches of new satellites) has produced the ability to have field-level data for every farm in Canada. Advances in sensor engineering, resolution quality, and better timeliness of data collection are increasing mapping quality with greater frequency. Data continuity has improved, creating time series back to 1980s. With better calibration, the results have given a good understanding of what has happened in the Canadian agriculture landscape. The difference between data and information are becoming more apparent through a new generation of agro-
environmental indicators. Through earth observation, information that was previously quite coarse is now more refined and currently there is improved information in hydraulics, drought and yield monitoring. Data processing now centralised at terabyte level can be done more quickly. Open data has led to improved yield forecasting and has the potential to continue to drive innovation.

26. Markus Muerth from the Vista GmbH presented the use of remote sensing at farm level from image to information. There is an imbalance between supply and demand in the global food system where more information on the supply side will provide important advantages to farmers and the supply-demand balance. Where conventional farming currently produces at 60% of potential yield, smart farming applications (smart fertilisation, smart plant protections, precision navigation, smart irrigation, crop simulation, smart seeding, and other techniques) accessible through big data can bridge this yield gap. Smart farming harnesses better knowledge. Information technology needs better data and Earth Observations to inform smart farming. Vista GmbH (funded by the European Space Agency ESA) has produced base maps of persistent relative fertility as basic information for farmers on the heterogeneity of their fields as well as for efficient and cost-effective soil probing. During vegetation season, near-real time biomass maps can give farmers greater sensitivity on both how and where to apply nutrients. Real time yield maps can provide feedback to the farmer to adjust farming techniques. PROMET, a crop growth model, provides future yield estimates with strong results when run with meteorological forecasting data and remotely sensed biomass maps. The ESA Sentinel 2 satellite is considered a game changer with large capabilities for agriculture remote sensing, collecting and providing a wealth of global level data freely available to farmers and businesses worldwide. The project is supported by the European Commission for 25 years. Data is the central commodity of the 21st century on the global level, but more importantly on the local level for the farmer to leverage knowledge into value. Access to data commodities should be free and open for the development of the global smart farm.

27. Zyed Jamoussi from Alkimea presented on big data use by large retailers. Alkimea is a company that assists businesses in using data for profits. Data storage is currently profitable, but moving forward, profitability will come from data use. The primary goal is to make data actionable, extracting the data and placing it in a workflow for efficient use. Retailers and brands are able to use consumer information (through loyalty cards) and thus flood the market on promotions that only are useful to 5% of the consumers. Retailers use the method to increase effectiveness and reach of promotion. Moving from brand centric to consumer centric analytics will offer a combination of products that the metrics have predicted consumers will or may need. Pooling data on the consumer from a range of information sources enables marketers to better understand the consumer population. Predictive modelling based on past consumer behaviour has the capability to predict future preferences and even frequency at which they prefer to receive promotions. The process of carpet bombing consumers with promotions needs to be re-engineered and redesigned so that the offer becomes more relevant and yields consumer loyalty to brand. Predictive and prescriptive insight for the consumer and for the product (which consumers are best for the brand) based on relevance and balance of investment by brand and retailer drives industry to be more consumer centred and oriented and thereby more profitable.

28. Christian Reimsbach-Kounatze, from the from the OECD’s Science, Technology and Innovation Directorate, prepared a presentation on mapping the policy issues raised by big data that was given by Catherine Moreddu. Data driven innovation for growth and well-being carries the key message that data driven innovation is not just about data but about the analytics and the derived potential for benefits. Public sector data has generated value across sectors already in OECD countries. Data is both an infrastructure and a capital with increasing returns. Linkages provide new insights and demonstrate two tensions. Firstly, to strike the right balance between openness and closed-ness for data boundaries and secondly, how to encourage disruptive innovation while mitigating risks. Systematic inertia due to risks may lead to a loss of short term profit, but long-term infrastructure changes the need for new regulations. SMEs adopt disruptive technologies at slower and lower rates although they would derive the most benefit. This carries strong
implications for the farm and food processing sector. For SMEs, barriers to implementation include insufficient skill set and slow uptake. The lack of data specialists represents missed opportunities for job creation. Policy considerations for the digital economy include not only networks but also data (group to share data for global food security has promoted data sharing for over 100 countries). The role of government is to encourage investments in data and data sharing, address shortages of data specialists, and anticipate disruptive technologies. There is a need for a holistic and strategic approach for new R&D and innovation.

29. Panel discussion following the second session was centred on three issues: the mechanisms that facilitate the adoption of big data and information technologies; the marginal or lasting effect of mid-term developments of disruptive technologies to bringing value-added for agriculture; and the message for policy makers.

30. Given the noted difficulties for adoption of big data and information technologies by farmers, absent the needed data specialists and gains in human capital, private companies may be able to serve as intermediaries to analyse and translate information for farm use. In the mid-term, as experienced in Canada, the ability to provide a wall of information through big data will have real effect in real time. In the last ten years, the release of the Landsat data provided billions of dollars of value to the economy. Additional satellites providing high quality data at low cost or freely, with the government providing tools to download, access and use will be a game changer. The key step will be to turn the data into value-added products by combining satellite data with other data and then making the data accessible through a public portal or internet site in a way that facilitates use for the average farmer. Downstream, food processors can use big data to better plan for harvest, adjusting machines and providing feedback for farmers. Retailers may be able to use big data through brands to influence consumer choices. The consumer may begin to expect more personalised and immediate services and marketing responses.

31. Big data technology is not neutral. Governments will need to be proactive and ready to assess the effects of big data and then address the challenges. Data technologies are potentially transformative. With a relatively short window of time to address global food insecurity, governments will need to react quickly. The role of government will be to encourage investment in big data, particularly for the case of big data in agriculture, and then make this data accessible to the farmer. Skills training for farmers through extension services and the creation of data specialists will build human capacity for access and use. For privacy concerns, governments will need to strike the right balance for sharing. Closed platforms offer sharing with measures of protection on data use. Due to nature of agriculture data and farm characteristics, even aggregated data stripped of identifiers may still carry the risk of being vulnerable to reverse engineering that could reveal confidential, sensitive or private information. The role of government in crowding out private sector growth in the commercial use of public data will be important.

32. Where countries have established regulations, data sharing discord arises from differing laws across countries and thus strong collaboration among countries will be needed to manage data across geographical boundaries. The Joint Experiment for Crop Assessment and Monitoring (JECAM) was cited as an example of collaboration under the G20 for best practices in establishing agreements on monitoring and sharing.

Session 3. International cooperation for innovation

33. Cooperation between public and private actors of the innovation system, at the national or international levels, improves the efficiency with which public funds are used, and the adaptation of innovation to demand leading to faster and wider diffusion. The pooling of resources and capacities is increasingly needed to address more complex or global issues requiring cross-sectoral and multidisciplinary approaches, notably in the bioeconomy and big data areas. Discussion focussed on
benefits from cooperation, mechanisms to facilitate the development, dissemination and application of appropriate science, technologies and techniques through international cooperation, and to overcome barriers to adoption, and how OECD analysis can contribute to the debate. Current collaboration efforts, challenges encountered between businesses and government were discussed with final discussion suggesting future OECD work.

34. Matthew Hooper, Counsellor (Primary Industries) from the New Zealand Embassy in Rome, presented New Zealand’s experience participating in and hosting the secretariat of the Global Research Alliance on Agricultural Greenhouse Gases (GRA). Launched in 2009 in Copenhagen, the GRA was created as a response to the challenge of growing more food without increasing greenhouse gas emissions. The work of the GRA is of increasing relevance in light of the recent COP21 outcome. There is direct link between increased agricultural productivity, increased resilience and lower GHG emissions intensity. By providing a framework for international research collaboration, the GRA leverages research results to make the most of the national resources of its members. While many regions are represented in the global membership of 46 countries (and growing), Africa remains a gap to be filled, primarily due to a higher priority on adaptation and resilience. Three GRA research groups (paddy rice, livestock and croplands) and one cross-cutting integrative research group have been established. While there is no mandatory reporting or funding obligations, participation does require active engagement by members. As a core output, the GRA provides scientific knowledge and connection to global research networks. Factors of success include an inherent logic based on the need for global solutions to a global problem, and voluntary participation based on national priorities. A strong conceptual framework, strong links between policy and research at the national level and active membership have been keys to the GRA’s success to date. Challenges for the GRA include resourcing issues, transferring research to the farmer and navigating the politics of climate change. Current priorities include enhancing the role of the GRA secretariat, communicating the links between improved productivity and lower GHG intensity, and building international capacity and capability.

35. Bruce McCallum, from the New Zealand Ministry of Business, Innovation and Employment, presented country experiences in international collaborations. New Zealand participates in the OECD's Collaborative Research Programme (CRP) on Biological Resources in Agriculture, involving research fellowships and conference sponsorship. It is also a founding member of the International Network on Sustainable Temperate Agriculture (TempAg), which facilitates collaborative research on: conceptual frameworks for defining agricultural sustainability; land use systems; and yield gaps. Furthermore, New Zealand recently became a member of two European Joint Programming Initiatives: Agriculture, Food Security and Climate Change (FACCE), and A Healthy Diet for a Healthy Life (HDHL). Future opportunities and challenges include the development of strategies and frameworks to better align and integrate related programmes, at both the national and international levels.

36. Emilio Ruz, from the International Cooperation Unit of INIA in Chile, presented the country experience of research cooperation in Latin America with a perspective from the developing world and as a recent OECD member giving insight to working with other countries in the region. The Chilean Strategy for International Cooperation (AGCID) is situated in the Ministry of Foreign Affairs and has laid out policy and strategy documents with objectives for inclusive and sustainable development, strengthened partnership for shared development, and strengthening the National System of International Cooperation for Development. The Agriculture Research Institute (INIA) has international agreements with research centres across the globe and is able to partner offering technical assistance and cooperation based on strength of programs. Chile has benefitted from cooperation with Canada (through a fellowship award from the CRP) in precision farming. With PROCISUR, a technological program integrating six Latin American countries, an agreement for collaborative research is renewed every 5 years upon review. For 2015-18, five strategic lines were envisioned around themes of sustainable intensification, climate change, family farming, value-added and institutional management. Cooperation through this model has proved
effective, allowing ineffective lines of research to be phased out and new research to be taken up. A recent Babethanol project serves as an example of a successful international collaboration on biomass for secondary ethanol production. The FONTAGRO regional fund for agricultural technology with sustainable financing for agricultural research and innovation is an example of institutional innovation with projects reaching final beneficiaries. The fund defines priorities and allocates funding for research projects in the Latin American and Caribbean countries through competitive mechanisms. Through these dedicated institutions, programmes and funds, Chile has found that international collaboration is essential to addressing the complexities of current and future scenarios. The OECD, particularly the CRP, has enhanced cooperation particularly in emerging issues.

37. Claire Jolly, from the OECD’s Science, Technology and Innovation Directorate, presented the Space Forum’s experience with data sharing with some of the top level activities from the Forum that may have application in agriculture. The OECD Space Forum has become increasingly relevant as the number of space satellites continue to be deployed. Satellite technologies have an important role in agricultural land planning. Increased international cooperation and innovation will arise as data policies and understanding increase. Common data formats and the ability of complementarity (e.g. using US data instrument on European satellites) are taking on increasingly prominent importance. While currently 70% of space missions have open data policies in principle, the question of how open these policies actually remain. Weather satellites provide a good example of international collaboration with an open data policy, following a mandate of global weather sharing from the WMO (World Meteorological Organization). Landsat provides an example of the effects of policy and use, where the 2006 decision to release data led to a clear increase land and agricultural data activity use. Lessons learned from sharing satellite data include: the commercialisation of raw data is not economically viable; open access impressively increases data use; and the social benefit is maximised when considering data as a public good. Open satellite data will mean that governments need to track data use and utility through evaluation and impact assessment. While the value of raw data is limited, it is the analytics that make it valuable. The demand for Earth observation is likely to increase as issues and research needs are better understood and expanded. The OECD has a key role through facilitating international cooperation for greater expertise in Earth observation and broadening the evidence base.

38. Hélène Lucas, International Scientific Coordinator of the G20 Wheat Initiative, presented an example of international collaboration at commodity level. The Wheat Initiative, launched in 2012, is a research partnership for wheat improvement to address the challenge of sustainably increasing wheat production through a framework to identify synergies, avoid duplication of efforts and facilitate collaborations among a global wheat research community. The Wheat Initiative is open to all interested countries and companies and involves currently 16 countries, 9 private companies and 2 CGIAR centres. Governance, aimed at facilitating communication between the research community, funders and policy makers, is provided through a research committee, an institution coordination committee and expert working groups. The Wheat Initiative has developed a Strategic Research Agenda (SRA) organised across four thematic themes: increasing yield potential, protecting yield, increasing sustainability and supplying quality products, and two cross-cutting themes: technologies and resources, capacity building. The next step for the initiative will be to implement the SRA at the national and international levels, building on the increased momentum through stimulating debate and discussion, and on the first collaborative actions such as the creation of a dedicated wheat information system. Through the initiative, trust has been built, but competition still exists for funds, leadership, etc. Engagement and long-term commitments are needed to further help research efforts, as well as mechanisms to fund international research programmes.

39. Frank van Tongeren, from the OECD’s Trade and Agriculture Directorate, presented the role of international regulatory cooperation in the diffusion of technology. Cooperation in regulation is important for the diffusion of technology, helping market expansion for innovators and reducing trade costs to enable global value chains. Regulation helps create trust from consumers and citizens who are more likely to trust
regulations from their own countries and coordinated regulations will help build global trust. International regulatory co-operation can create some regulatory certainty, enable disruptive technologies and avoid trade restrictive stocks that may accumulate at later stages. Hampered by regulatory heterogeneity among countries, countries begin to address regulatory issues individually. Regulatory bodies typically begin from a domestic perspective, considering science first, but may also include historical and cultural issues. Using the example of chocolate to illustrate international cooperation among European countries, the regulations, in response to strong public opinion, countries employed varying approaches (negative list, positive list, private standards/recipes, etc.). Following 30 years of regulatory conflict among European countries, a compromise was reached in 2003. For more complex and sensitive issues of gene editing, solutions will inherently be even more complex. Mutual recognition should be better defined between equivalence of outcomes and equivalence of conformity of assessment. Agreements should be underpinned by: regulatory impact assessment; good laboratory practice; international standards and transparency and early involvement of civil society (as much resistance comes when consumers are involved at late stages). While regulatory standards set by industry (e.g. ICT) may be efficient, collaboration across countries with industry may provide standards that build public trust and act in the public interest more effectively.

40. Peter Kearns, from the OECD's Environment Directorate, served as discussant for this session and opened the general discussion by citing the example of the environmental work of the OECD chemicals guide to evaluate product safety and toxicity where collaboration has been built through data collection where countries have submitted data and participated in the assessment process. Three questions guided the final discussion: the benefits and downsides of cooperation; mechanisms to facilitate collaboration in new areas; and key messages for governments, international organisations and public private partnerships.

41. Cooperation in innovation offers several benefits in research efficiency, diffusion of innovation and facilitating trade. Based on the presentations and experience, mutual learning was attained but through sustained and concerted efforts. Collaborations are viewed as necessitating investment but with reward.

42. A range of collaborations were presented during the workshop. High level alliances with committed participants produce good collaborations, but challenges for funding and gaining attention from policymakers exist as issues vie among a range of important topics. Competition exists at all phases of research, from basic research where scientists compete for research funding and first to publish to the development phase as innovations become ready for market. Within countries, governments prioritise a wide research agenda. Among scientists, there is competition for limited funding resources. With the global research agenda optimised and research areas competing for limited funds, incentives for collaboration will be needed for agricultural innovation broadly. Funding mechanisms that provide incentives for top researchers to collaborate may facilitate networks for critical issues. In developed countries, the private sector is well positioned to bring innovations to market, but incentives will be needed in developing countries.

43. Country policies vary in their approaches to similar issues and research priorities allowing countries to learn from one another the range of policy options and their effectiveness. Collaborations that include both developed and developing countries can use the substantive research base for greater impact. Regulations are needed but should not hamper innovation.

Meeting conclusions

44. Frank van Tongeren provided summary remarks for the workshop. Policy making for the bioeconomy will need a consensus and better working definition for the bioeconomy. While the research field holds promises, biorefinery related policy making is difficult in the current environment of low oil prices that weakens the business case for the need for biofuels. First level policies should focus on
removing fossil fuel subsidies. The bioeconomy has potential to improve food security through innovation, providing sustainable progress and inclusive growth for agricultural populations while maintaining competitiveness.

45. The next production revolution and transformational change of food and agriculture will occur through new technologies of big data with not only more information but increasingly better use of information. The current business model in agriculture will need to change including the role of the farmer in order to adapt to data driven technology. Farming skills may be de-personified (and taken over by software) and the skill set of the farmers broadens. Governments need to be able to develop rules and policies that balance costs and benefits. Yet, in a rapidly advancing technological environment, governments will face challenges to be pro-active rather than simply re-active. Opportunities in big data and real-time monitoring will open new avenues for policy design, in particular on agri-environmental policies.

46. Collaboration is particularly important in pre-competitive research and development. Governments can provide ongoing support for research collaboration and the optimisation of intellectual property rights protection. Policy coherence in the alignment of domestic and international programming of research, the alignment of research with regulatory implications, and the alignment of the education system with research needs will be important. An optimal allocation in R&D may include collaborative mechanisms where research done elsewhere is then adapted to local circumstances.

47. Implications for future OECD work include: informing policy makers of ongoing developments in innovation and technology, related to the bioeconomy and big data in order to help governments think ahead and be pro-active; helping identify and develop policies and regulations that enable innovations; identifying areas of relevance and importance, including big data for policy monitoring and environmental monitoring, to develop policies currently targeting production process rather than environmental outcomes; and lastly, continuing horizontal work streams in collaboration with the Directorate for Science, Technology and Innovation and the Environment Directorate.

48. In addition to general support for future OECD work, experts outlined a number of areas for government action:

- Policies on the management of big data including better oversight of big data management particularly agricultural data where there is vulnerability to private sector and market behaviour will help to protect farmers and privacy concerns.

- Policies to support common data exchange platform for sharing and analytics.

- Policies to encourage investments in data and data sharing, address shortages of data specialists, and anticipate disruptive technologies.

- Government should take an active role in providing the rules and regulations for disruptive technologies. Intervention in markets is essential so that the private sector or one leading business does not establish infrastructure or market conditions alone.

- Policies to facilitate single source reporting and data access at the public level.
# ANNEX. DRAFT AGENDA

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<td><strong>Introduction</strong></td>
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<td>- Ken Ash, Director for Trade and Agriculture (TAD)</td>
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<td>- Dominique Guellec, Head of Science and Technology Policy Division in the Directorate for Science, Technology and Innovation (STI)</td>
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<td><strong>14:30-17:30</strong></td>
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<td><strong>Session 1. Innovations in the bioeconomy</strong></td>
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<td><strong>Chair:</strong> Michael Ryan, OECD/TAD</td>
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<td>The bioeconomy encompasses the production of renewable biological resources and their conversion into food, feed, bio-based products and bioenergy. Biotechnology and the biorefinery concept are considered essential components. Innovations in these areas include new gene modification techniques, and the development of processes using a wider range of biological resources to obtain new products. Developments in the bioeconomy have numerous impacts on the food and agriculture sector: they can supply seeds improving natural resources efficiency and resulting in commodities better adapted to consumers' and industry's demand, but they also increase competition for land and other natural resource use between food and other biomass usage. Countries need to develop policy strategies to ensure a sustainable development of the bioeconomy, and need to regularly adapt regulations to new developments.</td>
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<td>- Genomics and the bioeconomy, <em>James Philp, OECD/STI</em></td>
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<td>- Sustainable Agriculture, Forestry and Fisheries in the Bioeconomy - A Challenge for Europe: 4th SCAR foresight exercise, <em>Erik Mathijs – Professor of Agricultural and Resource Economics at the Department of Earth and Environmental Sciences of the University of Leuven.</em></td>
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<td>- Bioeconomy in the Grand Strategy of Indonesian Agricultural Development, <em>Dr, Robert Manurung, Associate Professor, Department of Bioengineering, School of Life Sciences and Technology, Institut Teknologi Bandung.</em></td>
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<td>- The Age of gene editing, <em>Steffi Friedrichs, OECD/STI</em></td>
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<td>- Regulatory approaches to seeds, <em>Marcel Bruins, consultant.</em></td>
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## Session 2. Big data generated by Information and Communication Technologies

### Chair: Franck Jesus, OECD/TAD

Information and Communication Technologies (ICT) have multiple applications in food and agriculture. Internet-based simulation or forecasting tools, satellite imageries and connected tractors facilitate farmers’ decision-making and the implementation of precision agricultural practices. Data integration improves traceability along the supply chain and reduces information costs. Technologies that generate or make use of 'big data' are increasingly used in the sector, and new developments such as drones, could further improve the information base on which farmers make their decisions. At the level of policy implementation and monitoring, these technologies could reduce information asymmetries and improve the targeting of government programmes and reduce monitoring costs. The wider diffusion of the technologies, which offer promising applications, depends on whether the regulatory and policy environment addresses challenges in terms of privacy, organisation and interpretation of the information, and the costs and benefits of the associated tools, among others.

### Speakers and panellists

- **Big opportunities for big data in food and agriculture**, Krijn Poppe, LEI-WUR
- **USA Agriculture Big Data Situation**, John Fulton, Associate Professor, Agricultural Engineering, Ohio State University
- **Integrating the food system**, John Crawford, Rothamsted Research, Chief Executive Officer (CEO) of Agrimetrics.

#### Discussant on the role of new data sources in greening growth, Julien Hardelin, OECD/TAD

### Coffee break

- **Space for Agriculture: Opportunities to supporting a Competitive Agricultural sector in Canada**, Andrew M. Davidson, Earth Observation, Center for Agro-Climate, Geomatics & Earth Observation, Science & Technology Branch
- **From image to information**, Markus Muerth, Vista Remote Sensing in Geosciences GmbH
- **Introduction to big data activation in Retail**, Zyed Jamoussi, Alkimea, France
- **Data-Driven Innovation (DDI) for Growth and Well-Being:** Mapping the key policy issues, Christian Reimsbach-Kounatze, OECD/STI

### Panel discussion with speakers and panelists

### General discussion

### Summary

### Lunch Break
### Session 3. International cooperation for innovation

**Chair:** Matthew Worrell, Chair of the OECD Working Party on Agricultural Policies and Markets

Cooperation between public and private actors of the innovation system, at the national or international levels, improves the efficiency with which public funds are used, and the adaptation of innovation to demand leading to faster and wider diffusion. The pooling of resources and capacities is increasingly needed to address more complex or global issues requiring cross-sectoral and multidisciplinary approaches, notably in the bioeconomy and big data areas. Discussion will focus on benefits from cooperation, mechanisms to facilitate the development, dissemination and application of appropriate science, technologies and techniques through international cooperation, and to overcome barriers to adoption, and how OECD analysis can contribute to the debate.

**Speakers and panelists**

- International co-operation in food and agricultural sustainability research: the NZ experience so far, Bruce McCallum, Counsellor Science, Skills and Innovation, New Zealand Ministry of Business, Innovation and Employment; and Enabling international research collaboration: New Zealand’s experience with the Global Research Alliance (GRA), Matthew Hooper, Counsellor (Primary Industries), New Zealand Embassy in Rome, Ministry of Foreign Affairs and Trade (MFAT) - Manatū Aorere-

- Experience of research cooperation in Chile and Latin America, Emilio Ruz, Head of International Cooperation Unit of INIA, Chile

- Avenues for Cooperation: Satellite data Sharing and Impacts, Claire Jolly, OECD/STI


- International Regulatory Cooperation and Innovation, Frank van Tongeren, OECD/TAD

**Discussant:** Peter Kearns, OECD/ENV

**Panel discussion with speakers and panelists**

**General discussion**

**Summary**

17:00-18:00 **Concluding remarks by OECD**

Towards policy recommendations and implications for OECD work, Frank van Tongeren, OECD/TAD.