Leibniz Gemeinschaft

Der Senat

31. März 2020

Stellungnahme zum Leibniz-Institut für Gemüse- und Zierpflanzenbau (IGZ) e. V., Großbeeren

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Vorbemerkung

Die Einrichtungen der Forschung und der wissenschaftlichen Infrastruktur, die sich in der Leibniz-Gemeinschaft zusammengeschlossen haben, werden von Bund und Ländern wegen ihrer überregionalen Bedeutung und eines gesamtstaatlichen wissenschaftspolitischen Interesses gemeinsam gefördert. Turnusmäßig, spätestens alle sieben Jahre, überprüfen Bund und Länder, ob die Voraussetzungen für die gemeinsame Förderung einer Leibniz-Einrichtung noch erfüllt sind.[1]

Die wesentliche Grundlage für die Überprüfung in der Gemeinsamen Wissenschaftskonferenz ist regelmäßig eine unabhängige Evaluierung durch den Senat der Leibniz-Gemeinschaft. Die Stellungnahmen des Senats bereitet der Senatsausschuss Evaluierung vor. Für die Bewertung einer Einrichtung setzt der Ausschuss Bewertungsgruppen mit unabhängigen, fachlich einschlägigen Sachverständigen ein.

Vor diesem Hintergrund besuchte eine Bewertungsgruppe am 4. und 5. Juni 2019 das IGZ in Großbeeren. Ihr stand eine vom IGZ erstellte Evaluierungsunterlage zur Verfügung. Die wesentlichen Aussagen dieser Unterlage sind in der Darstellung (Anlage A dieser Stellungnahme) zusammengefasst. Die Bewertungsgruppe erstellte im Anschluss an den Besuch den Bewertungsbericht (Anlage B). Das IGZ nahm dazu Stellung (Anlage C). Der Senat der Leibniz-Gemeinschaft verabschiedete am 25. März 2020 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

1. Beurteilung und Empfehlungen

Der Senat schließt sich den Beurteilungen und Empfehlungen der Bewertungsgruppe an.

Das IGZ betreibt pflanzenwissenschaftliche Grundlagenforschung mit dem Ziel, die Qualität und Quantität von Produkten des Gartenbaus, insbesondere von Gemüsepflanzen, zu verbessern. Dazu forscht das Institut zur Anpassungsfähigkeit von Pflanzen an ihre Umwelt, zu Wechselwirkungen zwischen Pflanzen und Mikroben, zu Eigenschaften von Pflanzen und zu ihrer genotypischen Diversität. Darüber hinaus widmet sich das IGZ nachhaltigen Produktionssystemen im Gartenbau.

Das IGZ wurde zuletzt **2016** evaluiert. Der Senat übte damals erhebliche Kritik an den Strukturen des Instituts, das seinerzeit sowohl in Großbeeren als auch in Erfurt angesiedelt war. Er identifizierte gravierende Leistungsschwächen und beurteilte die drei Arbeitseinheiten in Erfurt als „nicht hinreichend“. Die zehn Einheiten in Großbeeren wurden positiv eingeschätzt. Bund und Länder folgten der Empfehlung, die institutionelle Förderung ausschließlich in Großbeeren fortzuführen. Die Grundausstattung des IGZ verringerte sich ab 2017 um 3,1 Mio. auf 7,5 Mio. EUR, knapp 20 % der Stellen mussten abgebaut werden. Der IGZ-Standort Erfurt wurde geschlossen. Die damit einhergehenden, äußerst schwierigen Aufgaben bewältigte die Institutsleitung sehr gut.

[1] Ausführungsvereinbarung zum GWK-Abkommen über die gemeinsame Förderung der Mitgliedseinrichtungen der Wissenschaftsgemeinschaft Gottfried Wilhelm Leibniz e. V.

Der Senat erwartete 2016, dass die Fokussierung auf Großbeeren die wissenschaftliche und administrative Steuerung des Instituts deutlich erleichtern und so zu einer Steigerung der Leistungen in Relation zu den für das Institut eingesetzten Mitteln führen würde. Senat sowie Bund und Länder sahen vor, nach vier Jahren zu überprüfen, wie sich das Institut unter den geänderten Rahmenbedingungen weiterentwickelt hat.

Es gelang der Institutsleitung unter der wichtigen und engagierten Beteiligung von Beirat und Aufsichtsgremium, eine grundlegende **Umgestaltung** des IGZ in Gang zu setzen. Die folgenden Punkte sind hervorzuheben:

- Die Konzentration des IGZ auf Großbeeren nutzte das Institut dazu, eine klare **organisatorische Struktur** zu schaffen. Das Institut ist nun in vier überzeugend ausgerichtete Programmbereiche gegliedert. Die früheren, ortsübergreifend angelegten und vor vier Jahren strukturell nicht überzeugenden *research domains* sind entfallen.
- Gegenüber der äußerst kritisch bewerteten Situation vor vier Jahren wurden **grundlagenorientierte Forschungen** verstärkt, so dass das Verhältnis zur Anwendung jetzt besser austariert ist. Die methodischen Kenntnisse zur Untersuchung regulatorischer Mechanismen, auch auf der genetischen Ebene, sind inzwischen am Institut vorhanden und müssen nun breit eingesetzt werden.
- Zu dieser neuen wissenschaftlichen Perspektive passt es sehr gut, dass ein **fünfter Programmbereich** „Genomik und Bioinformatik im Gartenbau“ aufgebaut wird. Dafür sind Mittel der institutionellen Förderung eingeplant. Das bereits weit vorangeschrittene gemeinsame Berufungsverfahren mit der Universität Potsdam für die neu geschaffene W3-Leitungsposition sollte nun zügig abgeschlossen werden. Ausbaupläne zur Erforschung der Rhizosphäre, für die zusätzliche Mittel erforderlich wären, sollten dagegen derzeit nicht weiterverfolgt werden. Die Integration der Entwicklungsökonomie muss wie geplant weiter vertieft werden.
- Das IGZ hat die Personalstruktur auf der Ebene **wissenschaftlicher Leitungspositionen** erheblich fortentwickelt. Zur Zeit der letzten Evaluierung waren der Direktor und zwei weitere leitende Wissenschaftler mit W2-Professuren am Institut tätig. Inzwischen wurden zusätzlich zwei W3-Professuren eingerichtet. Eine dieser Positionen ist seit 2019 sehr gut mit einem Wissenschaftler aus dem Ausland besetzt, die zweite Besetzung folgt nun (s.o.). Die Umwandlung ruhestandsbedingt vakant werdender Stellen wird dazu führen, dass ab 2023 alle Programmbereiche durch gemeinsam berufene Professorinnen bzw. Professoren geleitet werden. Neu zu besetzen ist zudem die Institutsleitung. Diese Position wird 2022 ruhestandsbedingt vakant.

Die örtliche Konzentration des IGZ auf Großbeeren erweist sich als richtiger Schritt, der die Profilbildung des IGZ erheblich voranbrachte. Die Neugestaltung bietet beste Voraussetzungen dafür, in den kommenden Jahren nun auch die **wissenschaftlichen Leistungen** zu erhöhen. Dieses Ziel ist derzeit noch nicht erreicht. Die Programmbereiche werden dreimal als „gut“ und einmal als „gut bis sehr gut“ bewertet. Es ist positiv, dass in den letzten Jahren mehr Ergebnisse in referierten Zeitschriften veröffentlicht wurden als zuvor am damals noch größeren IGZ. Es sind jedoch weiterhin deutliche Verbesserungen erforderlich. Insbesondere sollte wie vorgesehen eine Publikationsstrategie beschlossen

werden, damit die Ergebnisse so sichtbar wie möglich veröffentlicht werden. Um dies zu erreichen, muss das IGZ die Möglichkeiten seiner wissenschaftlichen Infrastrukturen besser ausschöpfen, auch im Rahmen von gemeinsamen Projekten mit Partnerinstitutionen.

Die intensivierten **Kooperationen** in der Region bieten dafür eine sehr gute Grundlage. Hervorzuheben ist die Gründung eines *Joint Labs* gemeinsam mit dem Deutschen Institut für Ernährungsforschung in Potsdam-Rehbrücke und die wichtige Kooperation mit dem Max-Planck-Institut für Molekulare Pflanzenphysiologie in Potsdam-Golm. Im Anschluss daran sollte nun, wie teils auch schon geplant, die Zusammenarbeit auf nationaler und internationaler Ebene ausgebaut werden.

Im Zeitraum von 2016-2018 schlossen 14 am IGZ tätige Doktorandinnen und Doktoranden ihre **Promotionsverfahren** ab, in der Zeit 2012-2014 waren es trotz deutlich umfangreicherer institutioneller Förderung lediglich zwei Abschlüsse mehr. Das IGZ rechnet damit, dass mit der steigenden Zahl von Professuren auch die Anzahl der Promovierenden zunimmt. Vor diesem Hintergrund sollte das *IGZ Graduate Student Programme* in höherem Maße verpflichtend und inhaltlich fordernder ausgestaltet werden.

Das IGZ hat sinnvolle Maßnahmen zur Vereinbarkeit von Beruf und Familie umgesetzt. Der **Frauenanteil** im Bereich Forschung und wissenschaftliche Dienstleistungen ist auch auf Leitungsebene erfreulich hoch, jedoch ist derzeit nur eine der momentan vier Professuren mit einer Wissenschaftlerin besetzt. Die anstehenden Stellenbesetzungen in den kommenden Jahren sollten für eine Verbesserung genutzt werden.

Die Ausstattung des IGZ mit **Mitteln der institutionellen Förderung** ist auskömmlich. Der Senat würdigt, dass das Institut die erhebliche Reduktion der Mittel ab 2017 sehr gut gestaltet hat. Die **Drittmittel** stiegen nach der Fokussierung auf Großbeeren sogar leicht, ihr Anteil am Budget erhöhte sich von 10 % (2012-2014) auf 14 % (2017-2018). Nach wie vor werden aber zu wenige Projekte im Wettbewerb eingeworben. Der positive Trend der letzten Jahre muss nun weitergeführt werden, insbesondere mit Blick auf DFG-Förderungen.

Der Senat begrüßt die sehr grundlegenden Maßnahmen zur strategischen Umgestaltung und Profilierung des auf Großbeeren konzentrierten IGZ. Sie müssen nun zu deutlichen Leistungssteigerungen führen. Nach dem Abschluss des laufenden Wechsels auf Leitungsstellen soll in fünf Jahren erneut beurteilt werden, ob das Institut weiterhin die Anforderungen erfüllt, die an eine Einrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischem Interesse zu stellen sind. Mit der Bearbeitung langfristig angelegter Fragestellungen des Gartenbaus auf der Grundlage umfangreicher und hochwertiger wissenschaftlicher Infrastrukturen erfüllt das IGZ Aufgaben, die in dieser Form nicht an einer Hochschule wahrgenommen werden können. Eine Eingliederung des Instituts in eine Hochschule wird daher nicht empfohlen.

2. Zur Stellungnahme des IGZ

Der Senat begrüßt, dass das IGZ beabsichtigt, die Empfehlungen und Hinweise aus dem Bewertungsbericht bei seiner weiteren Arbeit zu berücksichtigen.

3. Förderempfehlung

Der Senat der Leibniz-Gemeinschaft empfiehlt Bund und Ländern, das IGZ als Einrichtung der Forschung und der wissenschaftlichen Infrastruktur auf der Grundlage der Ausführungsvereinbarung WGL weiter zu fördern.

Außerdem empfiehlt der Senat, die nächste Überprüfung der Fördervoraussetzungen des IGZ in fünf Jahren (2025) vorzusehen.

22 May 2019

Annex A: Status report

Leibniz Institute of Vegetable and Ornamental Crops (IGZ) e. V., Großbeeren

Contents

1. Structure, tasks and institutional environment

Development and funding

The predecessor of the Leibniz Institute of Vegetable and Ornamental Crops (IGZ) was founded in 1924 as an agricultural research station of the Friedrich-Wilhelm-Universität in Berlin (now: Humboldt-Universität zu Berlin). After German reunification, the German Council of Science and Humanities (Wissenschaftsrat) suggested establishing a new horticultural research institute by joining several research groups in Großbeeren and Erfurt. The IGZ was finally set up in 1992 with joint funding by the Federation and the Länder.

Its national importance was confirmed in external evaluations in 2000 and 2008. In June 2016, though, based on a recommendation of the Leibniz Association Senate, the Federation and the Länder decided that the Erfurt site of IGZ should no longer be jointly funded. This decision became effective on 1 January 2017. As a consequence, the Leibniz-Institute IGZ is now solely based in Großbeeren in the state of Brandenburg.

Responsible department at *Länder* level: Ministry of Sciences, Research and Cultural Affairs (MWFK) of Brandenburg

Responsible department at federal level: Federal Ministry of Food and Agriculture (BMEL)

Mission and tasks

According to its new statutes (effective 3 April 2019), the IGZ is a scientific institution for fundamental plant research with a view on possible applications in vegetable and ornamental plant cultivation, and on the utilisation of plant biodiversity. IGZ conducts interdisciplinary, fundamental research to improve the understanding of plants and their interaction with the environment. The institute is dedicated to developing sustainable production systems in horticulture, increasing food safety and security, and improving human nutrition.

To this end, IGZ maintains close scientific cooperation with institutions of higher learning, non-university research institutions, as well as with institutions of horticultural practice. IGZ also collaborates with regional, national, and international institutions in research and teaching, often through joint appointments, and supports young scientists in establishing their careers. Additionally, the IGZ shall pursue knowledge and technology transfer within the scope of its statutory purpose and its goals.

Legal form and organisation

IGZ has the legal form of a registered association (eingetragener Verein, e. V.). Organs are the General Assembly, the Executive Board and the Science Advisory Board.

The General Assembly (GA) consists of the members of the Association. Full members are the Federal Republic of Germany, the State of Brandenburg, Humboldt-Universität zu Berlin, Universität Potsdam, the German Horticultural Producers Organisation, and the German Society for Horticultural Science. The GA is responsible for all fundamental matters of the Association. It determines the guidelines of the activities of the association and supervises the Executive Board. The new statutes of the IGZ aim at strengthening the strategic role of the General Assembly.

The Science Advisory Board (SAB) advises the Executive Board and the General Assembly on all important scientific and multidisciplinary issues. Members are appointed for a period of four years, and may be reappointed once. With the new statutes, the number of members of the SAB shall be increased to at least six and up to ten scientists. The aim is a better reflection of the interdisciplinarity in the institute's work.

At present, the Executive Board of the IGZ consists of the scientific director, the deputy scientific director, and the head of administration. Following the new statutes, the fourth member (one of the Programme Area heads) will be confirmed by the General Assembly in autumn 2019. According to the statutes, the scientific director is appointed by the General Assembly for a maximum of five years, and may be reappointed. He chairs the Executive Board, and manages and represents the institute.

Following the new IGZ statutes, the Research Staff Assembly will not any longer be a board of the institute, but will continue as an internal IGZ panel to support the work of the Executive Board and the Programme Areas.

Research structure

After the evaluation in 2015, IGZ was restructured (see chapter 3). Since January 2017, work at the institute is organised in four Programme Areas (PAs), ten Research Groups (RG) and two Junior Research Groups. In the Organisational chart (see Appendix 1) a fifth Programme Area that will start to work in 2019 is foreseen.

The IGZ provides central infrastructure in greenhouse and field facilities as well as nutrient analytics. All other IGZ technology platforms are maintained and made available in the different Programme Areas. The administrative unit was restructured in 2018, with a new head of administration and a new head of financial affairs.

National and international scientific environment

IGZ sees itself as a research institute with a focus on horticulture, which requires a broad thematic scope based on the triad plant-food-environment. Its research profile embraces interdisciplinary horticultural issues combined with aspects of environmental and life sciences as well as social sciences and economics. IGZ states that its profile is distinct from plant research institutions that have a sole focus on fundamental research, and that the IGZ also differs from research centres close to application only.

On the national level, there are several institutions of higher learning with research groups or programmes in horticulture, e.g. Humboldt-Universität zu Berlin (HU Berlin), Leibniz University Hannover, TU München, Universität Hohenheim, Hochschule Weihenstephan-Triesdorf, Hochschule Geisenheim University, and Fachhochschule Erfurt.

Complementary research is carried out at a number of non-university institutes, e.g. in plant-microbe interaction and agricultural practices (Leibniz Institutes IPB, ZALF, IPK[1] and the Helmholtz Centres UFZ, HMGU[2]), as well as in plant-environment interaction at

[1] Leibniz Institute of Plant Biochemistry (IPB), Leibniz Centre for Agricultural Landscape Research (ZALF), Leibniz Institute of Plant Genetics and Crop Plant Research (IPK)

[2] Helmholtz Centre for Environmental Research (UFZ), HelmholtzZentrum München – German Research Center for Environmental Health (HMGU)

the Max Planck Institute of Molecular Plant Physiology (MPIMP) and the Forschungszentrum Jülich. Other non-university research institutes with strong links to IGZ themes include the German Institute for Human Nutrition (DIfE) and a number of federal research institutes under the umbrella of the BMEL, such as the Max Rubner-Institute (MRI), the Thünen-Institute (TI), and the Julius Kühn-Institute (JKI).

In Europe, Wageningen University & Research is the anchor institution of horticultural research. According to IGZ, other leading institutions in Europe with research groups or programmes that interface with horticulture are, for example, the National Institute for Agricultural Research (INRA, France), the John Innes Centre (UK), the Research Institute of Organic Agriculture (FiBL, Switzerland), and the Swedish University of Agricultural Sciences (SLU). Internationally, e.g. UC Davis, University of Florida, Purdue University and other universities in the USA, Agriculture and Agri-Food Canada (AAFC), Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), and the Volcani Center (Israel) include horticultural research in their scientific portfolios.

The Food and Agriculture Organization of the United Nations (FAO) as well the research and development institute World Vegetable Center (WorldVeg, formerly AVRDC) have a declared interest in applied horticultural research to alleviate poverty and malnutrition in the developing world. The Consultative Group on International Agricultural Research (CGIAR) with its institutes worldwide is a global research-for-development organisation working on applied solutions to improve agricultural biodiversity and attain global food and nutrition security.

National interest and justification for funding as a non-university institution

According to IGZ, a national interest in its work results from the supra-regional relevance of its research topics that reflect current challenges such as sustainable food supply under conditions of climate change, food choices with high levels of nutritious and health-promoting compounds, and the development of climate-friendly food production systems. The IGZ claims a unique selling point with its combination of plant, microbial, environmental, food, data and social research perspectives with a focus on horticultural themes. In addition, IGZ sees itself as a qualified mediator between horticultural practice and science, thus underlining its supra-regional significance and relevance for national science policy.

The IGZ states that it is well positioned as an independent, non-university institution because of its interdisciplinary research profile, long-term research cooperations and up-to date analytical research infrastructure. It performs research with a medium- to long-term perspective and sees itself as a relevant and strategic partner within the scientific community, for policy makers, the public and various stakeholder groups in applied horticulture.

2. General concept and profile

Development of the institution since the last evaluation

After the evaluation in 2015 and the subsequent loss of funding for the Erfurt site, the IGZ was restructured. Following the recommendations, the previous matrix structure was suspended and replaced by a new organisational structure (see Appendix 1). The new IGZ research programme was approved by the General Assembly and implemented by 1 January 2017.

The restructuring process was designed and executed by the IGZ Executive Board, after consultation with the Science Advisory Board and in discussion with IGZ Department heads and scientists. This process aimed for sharpening the IGZ profile with horticulture as the core subject and for achieving a new balance between fundamental research and practical relevance. In its own view, the institute now focusses on a number of key areas and key competencies reflected by the research topics of the four programme areas: "Functional plant biology" (PA FUNCT), "Plant-microbe systems" (PA MICRO), "Plant quality and food security" (PA QUALITY) and "Next-generation horticultural systems" (PA HORTSYS). Each programme area consists of two or three research groups.

With a view to strengthen its profile, IGZ newly appointed the following scientific staff on the leadership level:

- Head of the Programme Area “Functional plant biology” (PA FUNCT); W3-Professorship for “Plant Nutritional Genomics” as a joint appointment with Universität Potsdam and in cooperation with the Max Planck Institute of Molecular Plant Physiology (MPIMP) in 2018
- Head of the Research Group “Food chemistry and human nutrition” (QUALITY.2); W2-Professorship on “Analytical Food Chemistry of Secondary Plant Metabolites” as a joint appointment with Universität Potsdam in 2018
- Head of the Research Group “Controlled Environment horticultural systems” (HORTSYS.2) in 2017

Another leadership position was established with third-party funding:

- Head of Junior Research Group “Optimisation of glucosinolate degradation pathways” (RG QUALITY.1.2), since 2018 funded by a grant from the Leibniz “Best Minds” competition

In January 2019, the former head of the Erfurt site left IGZ to take on the leadership of the new “Erfurt Research Centre for Horticultural Crops”.

Since the previous evaluation and in response to the recommendations of that evaluation, the IGZ Executive Board, together with the Programme Area heads and the IGZ scientists, modified the profile of the Institute. Aims were, for example:

- **Forward-looking research** as reflected in new joint projects (e.g. “SiEUGreen” - Sino-European innovative green and smart cities, and “Food*4*Future”) and the “LandInnovation” (collaboration between the IGZ and Brandenburg University of Technology Cottbus-Senftenberg) initiative.
- **Strengthening interdisciplinary food security research** by conducting joint projects spanning plant sciences, plant analytics and socio-economic aspects (e.g.

"HG4RR" and research activities on sustainable and climate-resilient intensification of cropping systems, e.g. "LiK", "Hortinlea").

- **Strengthening knowledge transfer and collaboration with industry**: The knowledge transfer between IGZ and practitioners is represented in projects such as "BasilBreeding", "ResistantTestMethod", and "N-Expert".
- **Strengthening strategic networking within the IGZ** by regular Research Group leader meetings, institute colloquia, and student seminars as well as by jointly used technical platforms (e. g. proteomics, metabolite analyses, environmental simulation facilities).
- **Strengthening advisory and steering mechanisms within the IGZ** by designating a new position in science management for the support of proposal development in respect to relevant calls. Steering mechanisms within the institute have been simplified by strengthening the responsibility of the IGZ Programme Areas for quality assurance, suspending the earlier matrix structure of the institute.

Results

For a description of concrete results see Chapter 3. Here, the overall scientific output of the IGZ is analysed.

Research

In the period 2016-2018, IGZ scientists contributed to 460 publications[3], 42% of them articles in peer-reviewed journals (see Appendix 2 for details). Compared to the previous evaluation, the number of peer-reviewed papers increased slightly (194 in 2016-2018, 181 in 2012-2014) despite the drop in the number of institutionally funded scientists. IGZ states that in the same time period, the average impact factor of IGZ peer-reviewed publications increased from 3.1 to 3.4. Also, according to the institute, the high percentage of peer-reviewed publications with external collaboration partners (84% of all IGZ peer-reviewed publications in 2016-2018) demonstrates the connectivity of IGZ researchers with research groups at other institutions.

IGZ claims that the largest share of its peer-reviewed publications now occurs in plant science journals. The share of IGZ publications in food science journals remains high, and the share of publications in microbiology journals has also increased since the previous evaluation. For the institute, publications with emphasis on applied research or science-based innovations ("articles in other journals") maintain some importance, albeit at a lower quantity. Here, the total number of publications dropped slightly from 60 (2012-2014) to 50 (2016-2018).

IGZ strives for the highest possible quality in publications in each of the different areas of its research. Measures to enhance the publication record include:

- The impact factor of the journal where IGZ papers are published is a criterion in performance-based funding.
- The IGZ offers writing courses not only for next-generation scientists, but also for established researchers.

[3] Including contributions accepted for publication and online first publications.

- IGZ actively supports open access publishing and "FAIR" (Findable, Accessible, Interoperable, and Re-usable) Data Principles.

Scientific consultancy

IGZ scientists contribute their expertise to the public discussion. The institute highlights the following scientific consultancy issues:

- Several statements to the Federal Ministry of Food and Agriculture (BMEL) on possibilities and limitations of the proposed adaptations on the national law on fertilisation (Düngegesetz).
- Regular statements on new plant breeding methods and the corresponding European and German legislation are made via the European Plant Science Organisation (EPSO) with input by IGZ.
- A statement to the Landtag (Parliament) Brandenburg on the expected risks of climate change on regional agricultural and horticultural production.

Knowledge and technology transfer

According to the institute, IGZ scientists keep in close contact with the horticultural industry and are frequently invited to present their results at meetings of growers, breeders and their associations. Practitioners are targeted via consultancy instruments, for example via

- "N-Expert", a decision support tool (software) for the optimal use of nitrogen fertiliser
- "DiControl", a BMBF-funded consortium that will develop policy advice for strategies in sustainable agricultural practice preserving soil fertility.

Third-party-funded projects that connect IGZ with companies are e.g. "Food*4*Future", EIP-Agri projects "NewSoil21" and "AMF-Agri", "BasilBreeding" and "ResistantTestMethod".

Scientific services and infrastructure tasks

The phytotron with its Gas-Exchange Greenhouse (GEG) is the backbone of IGZ plant research. It has contributed to attract grants for projects as well as new cooperations with other institutes. These facilities allow crop experimentation all year round. Other IGZ greenhouses are also used for plant experiments, mostly during the vegetation period from spring to late autumn. The IGZ has 1.3 hectares of field experimental area in Großbeeren. A second experimental station in Golzow will be discontinued, in favour of more on-farm experiments. All IGZ infrastructure is open for use by collaborating universities and research institutes, based on cooperation agreements.

Academic events and public relations

Scientists from IGZ contribute to conferences, workshops and other scientific events in horticulture and other fields related to their research area. They are involved in the organisation and co-organisation of international conferences and events in and outside Europe, e.g. the Annual Life in Kyrgyzstan Conference, the 14th International Asparagus Symposium (2017), the 4th International Glucosinolate Conference (2017), and the International Symposium on The Plant Microbiome (2018).

IGZ organises events for the public at the institute, e.g. the annual "IGZ-day of open doors". Staff often participate in public events such as Science Days and Nights in and around Berlin and Brandenburg and the Boy's and Girl's Day for school children. Furthermore, IGZ scientists contribute to events like the Fascination of Plants Day initiated by EPSO, *Internationale Grüne Woche* and the *Internationale Pflanzenmesse*.

Strategic work planning for the next few years

In the future, bioinformatics, genomics and digital sciences will be an important focus area of horticultural research at the IGZ. Therefore, the institute plans to establish a **fifth Programme Area "Genomics and bioinformatics in horticulture"** (BIOINF) from its core budget. In 2018, the position of the head of the new Programme Area was advertised as a joint professorship (W3) with Universität Potsdam. The selection procedure is under way. The new professor is expected to establish a new Research Group on genomics and bioinformatics in horticultural crops. A major research focus should be on the development of bioinformatics tools that can also leverage other Programme Areas and collaborations, and on the analysis of genomics data from crop plants and their associated microorganisms.

Moreover, IGZ plans to **strengthen rhizosphere research** at the institute across several Programme Areas. The aim is to work on the multifunctionality of plant use systems with a focus on rhizosphere processes, resource-use efficiency on the plot and area-scale level based on, (1) the characterisation of interactions between plants and the microorganisms and their diversity, (2) on the assessment of the diversity of physiological trait combinations, and (3) on soil-plant-land area functioning relationships. The research focuses will be linked and integrated by combining the analyses of species interactions across scales with resource flux analyses. The research will comprise aspects of rhizosphere processes concerning plant health, plant nutrition, nutrient fluxes, plant quality and plant-microorganism interactions. It will link basic and translational research, with the aim to understand and manage biodiversity effects from a small plot to a large area, in order to increase the multifunctionality of horticultural systems and achieve sustainable and climate-smart land use together with high yields and product quality.

<u>Minor extraordinary item of expenditure of a scientific-strategic nature</u>

In order to strengthen rhizosphere research to become a focus at the institute, the IGZ aims for additional funding for two new joint professorships and their working groups:

- A joint W3-professorship on "Biodiversity and Sustainability in Horticulture" with the Department of Biology, Chemistry and Pharmacy at the Freie Universität Berlin (FU Berlin), which focusses on basic aspects of biodiversity research. The primary specific focal area of the joint professorship will be plant-microbe interactions in the rhizosphere and resource allocation between plants and the rhizosphere microbiome. It will contribute to Programme Area "Plant-microbe systems".

  Staff: 1 Professor (W3), 2 Postdoc positions (E13/E14), 1 PhD position (E13/E14) and 1 Technical assistance (E2 to E9)

  Consumables: 72 k€

- A new junior professorship (W1) will work on the use of biodiversity in horticulture. The denomination and affiliation within IGZ and the preferred university for collaboration will be decided after a competitive procedure within IGZ. Each Programme Area of the IGZ will develop a proposal to strengthen biodiversity research in their area of competence. The proposal that has best scientific quality and contributes most to the IGZ profile will be financed and a junior professorship will be advertised.

  Staff: 1 Professor (W1) and 2 PhD positions (E13/E14)

  Consumables: 41 k€

	2022	**2023**	**2024**	**2025**	**Permanent**
IGZ funds + additional funds = "extraordinary item of expenditure"	*730 k€*	*752 k€*	*775 k€*	*798 k€*	*798 k€*
IGZ funds from existing funding by institution (at least 3 % of core budget)	*248 k€*	*256 k€*	*263 k€*	*271 k€*	*271 k€*
Additional funds - institutional funding	*482 k€*	*496 k€*	*512 k€*	*527 k€*	*527 k€*

Appropriateness of facilities, equipment and staffing

Appendix 3 gives a detailed list of IGZ's revenue and expenditure from 2016 to 2018.

In 2018, IGZ's revenue totalled approximately 10 M€. Due to the loss of the Erfurt site, the institutional funding of the IGZ was decreased from 10.6 M€ in 2016 (last year with both sites) to 7.5 M€ in 2017. The number of staff had to be decreased accordingly (for personnel see chapter 5).

Compared to the last evaluation, the IGZ has enhanced the acquisition of third-party funding. In 2012-2014, on average, revenues from grants amounted to 1.1 M€ p.a. (10.4% of the total revenue), in 2016-2018 it averaged out at 1.3 M€ p.a. (12.6% of the total revenue). Also, DFG funding has increased from 82 k€ per year (average revenue 2012-2014) to 157 k€ per year (2016-2018). IGZ states that in 2018 alone, 3 M€ of new grants were acquired, making 2018 the most successful year in grant acquisition in IGZ history.

IGZ states that the largest share of third-party funding in the 2016-2018 period came from the German Federal Ministries (77%), particularly the Federal Ministry of Education and Research (BMBF). The average share of funding from the DFG increased compared to the previous reporting period (from 8% to 13%).

The IGZ has 1.3 hectares of field experimental area in Großbeeren. It maintains facilities for proteomics, metabolomics and plant secondary compound analytics. The institute sees a need for a new multipurpose building that will provide space for the expanding Programme Areas "Functional plant biology" and "Genomics and bioinformatics in horticulture".

3. Subdivisions of IGZ

Programme Area "Functional plant biology" (PA FUNCT): as of 31. December 2018: 8.5 Full-time equivalents [FTE], thereof 1.3 doctoral candidates and 2.4 FTE service staff

The Programme Area was founded in 2017 with the aim to contribute to the mechanistic understanding of how plants interact with their environment, thereby expanding the former Research Area "Molecular basis of plant performance" [RA 2.6]. The Programme Area head was appointed in January 2019.

Current and future research in PA FUNCT is devoted to the overarching question of how plants react to environmental parameters, including temperature changes. Subsequently, PA FUNCT seeks to identify how plants can adapt to ever increasing environmental constraints and in the long term to translate the knowledge gained into crop improvement strategies. The PA focuses on identification and characterisation of genes and networks that enable environmental adaptation in plants, particularly those relevant to horticultural plants.

According to IGZ, the work in the department is interdisciplinary and uses a variety of approaches, including induced genetic screens, natural variation, proteomics, gene expression analysis and bioinformatics. It has its own next-generation sequencing capacity that greatly facilitates genome-wide analysis of transcription factor binding and gene expression programs. The institute states that available genome information in combination with next generation sequencing technologies now allows the extension of genomics-based functional studies to non-classical model plants that include important horticultural crops. IGZ plans to expand the CRISPR-Cas9 capability at the institute.

The major research activities of the PA are the following:

- Plant Growth and Metabolism: Identification, characterisation, and modification of control mechanisms of metabolism, growth, and developmental processes that can be used to improve crop plants
- Mechanisms of Resistance and Stress Tolerance: Elucidation of basic mechanisms of plant responses to environmental parameters and their importance for stress tolerance

The PA FUNCT is organised into three Research Groups (RGs):

- The task of the RG "Temperature sensing in plants" (RG FUNCT.1; since 2019) is to identify the underlying mechanisms of temperature perception in order to breed climate resilient crops. The model system *Arabidopsis thaliana* is used for this purpose.
- RG "Plant metabolism" (RG FUNCT.2: 2.8 FTE in research; 1.3 FTE doctoral candidates) conducts research to gain knowledge about transcriptional and translational networks that enable plants to respond appropriately to changing environmental conditions.
- The aim of the RG "Root-shoot interactions" (RG FUNCT.3: 1 FTE in research) is to enable a better informed selection of rootstock/scion combinations in order to minimise the negative effects of transplantation on quality.

In the period 2016–2018, researchers in the department published 22 articles in peer-reviewed journals (including accepted articles), 1 monograph and 6 individual contributions to edited volumes. In the same time period, the programme area spent third-party funds amounting to 209 K€. Thereof 165 K€ came from the DFG and 36 K€ from the Federal and *Länder* governments.

Programme Area "Plant-microbe systems" (PA MICRO): as of 31. December 2018: 19.6 FTE, thereof 5.9 FTE doctoral candidates, 5.5 FTE service staff)

The Programme Area was founded in 2017. It evolved from the former Research Areas "Biological principles for the optimisation of integrated pest management" [RA 2.3] and "Function of root-fungus interactions" [RA 2.5] and focuses on plant-microbe interactions.

The work of the Programme Area aims to unravel the complexity and functionality of plant-associated microbial communities at the molecular and physiological level. It analyses the effect of abiotic and biotic stress on the plant holobiont. The expected results aim to contribute to the development of innovative sustainable cultivation systems and novel environmentally friendly crop protection strategies.

The PA uses 'omics' technologies at DNA, RNA, and protein levels, bioinformatics, molecular biology, phenotyping, and modelling to study the structure, function, and activity of plant-associated microorganisms, and to assess the response of the plant to microorganisms (beneficial and pathogenic) and environmental stress. Within the framework of the project "DiControl", it could be shown that long-term agricultural practice (e.g. soil treatment, fertilization regime and previous crop) significantly influences microbial communities in the soil and rhizosphere. The observed changes could be linked to plant health and productivity.

The major research activities of the PA are the following:

- Research on the effects of abiotic (drought, salinity) and biotic (soil-borne pathogens) stress on plant health and productivity. Investigation of the role of microbiota in this context (e.g. plant growth promotion and disease control)
- Analysis of the effects of agricultural practice on soil and rhizosphere microbiota and their role in plant health and productivity in cultivation systems
- Translation of the results into horticultural production systems (hydroponics, field) in cooperation with PA HORTSYS

The PA MICRO is organised into two Research Groups (RGs):

- The RG "Principles of integrated pest management" (MICRO.1: 8.8 FTE) focuses on particular plant defence processes against root pathogens. The RG studies the influence of farming practices, such as tillage practice, fertilisation regimes, and crop rotation on soil and rhizosphere microbiota profiles, plant health, and productivity.
- The work of the RG "Beneficial plant-microbe interactions" (MICRO.2: 5.3 FTE) aims to understand the effects of beneficial bacteria and fungi on plant performance and to elucidate the mechanisms of interactions between plants and microbes and the environment. Plant-microbe interactions are analysed in order to apply microbes in horticultural production systems.

In the period 2016–2018, researchers in the department published 73 articles in peer-reviewed journals (including accepted articles), 5 monographs and 118 individual contributions to edited volumes. In the same time period, the programme area spent third-party funds amounting to approx. 1.2 M€. Thereof 22 K€ came from the DFG, and 1 M€ from the Federal and *Länder* governments.

Programme Area "Plant quality and food security" (PA QUALITY): as of 31. December 2018: 20.2 FTE, thereof 3.5 FTE doctoral candidates, 6.9 FTE service staff)

The Programme Area started to work in 2017 in the frame of the new IGZ research structure. It is a continuation both in themes and personnel of the former Research Domain "Horticulture, environment and the consumer" [RD 3].

The objective of the PA is to generate interdisciplinary knowledge grounded in life sciences and social sciences, in order to strengthen sustainability, human nutrition, and nutritional food security for all. The research of the Programme Area focuses on three priority areas:

- horticultural diversity,
- malnutrition associated with chronic diseases and
- targeted induction of plant secondary metabolites (PSMs).

This is done by focussing on genotypic diversity and targeted influencing of PSM through altering of physiological processes in planta. The biofunctionality of selected plant metabolites, both in the interaction between plant and environment and in human nutrition, is outlined by setting up a state-of-the-art analytical platform. In addition, the impact of vegetable production and consumption on food security and livelihoods is investigated, including in developing and fragile countries.

The platform of targeted and non-targeted approaches was expanded by investing in analytical instruments such as GC-QToF.

The PA investigated the composition of PSMs and corresponding biofunctionality in indigenous Asian and African vegetables focussing also on underutilised species such as Ethiopian kale, African nightshade, spider plant and amaranth. One result is the identification and quantification of constitutive high concentrations of novel hydroxycinnamic acid derivatives in leaves of amaranth genotypes and the discovery of their anti-inflammatory effect. The role of home and school gardens on nutritional and food security was analysed. Additionally, the PA built up a panel dataset of agricultural development, household coping strategies, and food security in Kyrgyzstan.

Prospectively, concerning horticultural diversity, (longitudinal) survey data at the individual, household and community levels will be analysed to generate a combined data set of economic, human health, and plant metabolite parameters. In respect to targeted induction, the PA extends work in the BMBF "SEcondaRy UV" project on narrow-band UV-B triggering the formation of secondary plant metabolites. In the BMEL-funded "CarCauli" project, the focus will be on understanding the regulation of the carotenoid metabolism in coloured cauliflower cultivars grown under different environmental conditions, especially with respect to light.

The PA QUALITY is organised into three Research Groups (RGs) and two Junior RGs, included into RG QUALITY.1:

- The RG "Plant quality for human consumption" (QUALITY.1: 9 FTE) focusses on the identification, quantification and characterisation of PSM such as (Se) glucosinolates and their breakdown products, phenolic compounds, and saponins in (underutilised) plant species for developing strategies for generating food products.
    - Junior RG "Detection, biosynthesis and function of flavonoids" (QUALITY.1.1) focused on physiological consequences of light quality, in particular UV, on biosynthesis of flavonol glycosides. The Junior RG leader has obtained a professorship at Universität Göttingen for "Quality and sensory properties of plant products", and has left IGZ in March 2019.
    - Junior RG "OptiGluP – Optimization of Glucosinolate Degradation Pathways" (QUALITY.1.2) focuses on enhancing the availability of health beneficial compounds by optimizing the breakdown pathways of glucosinolates in *Brassica* vegetables. It is funded by the "Leibniz Best Minds" programme.
- RG "Food chemistry and human nutrition" (QUALITY.2: 2.2 FTE) investigates regulatory mechanisms of the carotenoid homeostasis in vegetables and vegetable products as well as resulting changes in bio-functionality using state-of-art analytical technologies complemented by molecular biology approaches.
- RG "Economic development and food security" (QUALITY.3: 2.1 FTE) studies the role of plant quality for farm production and human consumption from a development and agricultural economics perspective at the micro-level.

In the period 2016–2018, researchers in the department published 85 articles in peer-reviewed journals (including accepted articles), 3 monographs and 33 individual contributions to edited volumes. In the same time period, the programme area spent third-party funds amounting to approx. 1.3 M€. Thereof 267 K€ came from the DFG, 816 K€ from the Federal and *Länder* governments.

Programme Area "Next-generation horticultural systems" (PA HORTSYS): as of 31. December 2018: 14.8 FTE, thereof 0.7 FTE doctoral candidates, 5.1 FTE service staff)

The Programme Area was newly composed and implemented in 2017, following recommendations of the previous evaluation to restructure activities in the former Research Domain "Horticultural practice and urban horticulture".

Key scientific and transfer activities of PA HORTSYS are:

- Development of decision support systems (DSS) and control algorithms
- Modelling plant growth and development
- Modelling physical greenhouse processes and plant-climate interaction
- Modelling nutrient cycling, water cycling, and soil heterogeneity
- Precision horticulture

- Analyses and determination of the most suitable management strategies for different systems, for example ecological farming, facade greening, and vertical cultivation

PA HORTSYS analysed the mechanisms of the complex interaction of plant and soil with respect to nutrient use, and the nitrogen mineralisation in soil from different sources. The DSS N-Expert was enhanced to estimate the nitrogen available to plants released from soil organic matter, crop residues and organic fertilisers, while gaseous nitrogen losses (N_2O and NH_3) from crop residues influenced by soil management were also analysed. Moreover, the effect of symbiotic microorganisms on the nutrient availability to plants was investigated. PA HORTSYS works in an EU-China network-project on recycling fertilisers for horticulture, develops in collaboration with industry a green wall prototype for plants in harsh urban environments, and is the coordinator of a national model and demonstration project for sustainable nitrogen fertilization in open-field vegetable cultivation. In order to manage nutrients in field conditions, IGZ expertise in mapping and modelling soil heterogeneity is used in soil process modelling of soil pH and economic yields.

The PA HORTSYS is organised into two Research Groups (RGs):

- RG "Open field horticultural systems" (HORTSYS.1: 5.5 FTE) develops models and decision support systems (DSS) that allow resource-saving production and at the same time can be adapted to changing climate conditions.
- RG "Controlled Environment horticultural systems" (HORTSYS.2: 3.5 FTE) conducts research on 1) optimising cultivation conditions for crop growth/quality and resource consumption with early detection and mitigation of stress; 2) use of phenotyping methods and soft-sensors; 3) optimal design and control of synergic cultivation systems; 4) microclimate optimisation for healthy products in vertical farming systems.

In the period 2016–2018, researchers in the department published 34 articles in peer-reviewed journals (including accepted articles), 10 monographs and 35 individual contributions to edited volumes. In the same time period, the programme area spent third-party funds amounting to 856 K€. Thereof 167 K€ came from the EU, 687 K€ from the Federal and State governments.

4. Collaboration and networking

During the reporting period (2016-2018), the IGZ collaborated in research projects with a total of 128 institutions from 17 countries and has jointly published with 184 institutions from 40 countries.

Collaboration with universities

Particularly close relationships exist with Universität Potsdam (UP) and Humboldt Universität zu Berlin (HU). The current joint appointments are:

- W2-Professorship for "Physiology of Plant Nutrition" (HU Berlin, Faculty of Life Sciences),
- W2-Professorship for "Plant Metabolism" (UP, Faculty of Science),

- W2-Professorship for “Analytical Food Chemistry of Secondary Plant Metabolites” (UP, Faculty of Science),
- W3-Professorship for “Plant Nutritional Genomics”, (UP, Faculty of Science).

In addition, one scientist holds an adjunct professorship with Leibniz University Hannover, and another scientist is Visiting Professor at The London School of Economics and Political Science (LSE). The head of the Erfurt site held a joint appointment on Molecular Phytopathology with HU Berlin.

Concrete plans exist (see Chapter 2 “Strategic work planning”) for the following joint appointments:

- W3-Professorship on “Genomics and bioinformatics in horticulture” (with Universität Potsdam, core funding),
- W3-Professorship on “Biodiversity and sustainability in horticulture” (with FU Berlin, additional funding),
- W1-Professorship (additional funding).

Additionally, IGZ plans to create new joint positions in the near future, partly in replacement of retirements:

- Professorship with the Life Science Faculty of HU Berlin on “Molecular Phytopathology/Plant-Microbe Interactions” (2020). Discussions with HU Berlin are ongoing at present. The appointee may in the medium-term act as head of Research Group “Beneficial plant-microbe interactions”.
- Professorship on “Plant systems research” (2020) as head of Programme Area “Next-generation horticultural systems”.
- Professorship on “Agriculture, Livelihoods and Food Security in Fragile and Conflict-affected Areas” with HU Berlin (2021, possibly third-party funded), as head of Research Group “Economic development and food security”.
- Professorship with a focus on plant-physiological processes as successor for the current head of Programme Area “Plant quality and food security” (2023/2024).

Also, in 2022 the IGZ scientific director will be 65 years old. IGZ suggests that clear procedures be defined at the appropriate time to guarantee continued leadership.

In total, during the reporting period, 18 IGZ scientists contributed to the teaching programmes at nine German partner universities. The interaction with regional universities is also demonstrated by the participation of an IGZ scientist in the Collaborative Research Centre “Priming and Organismic Responses to Stress” (CRC 973, 2016-2020, Freie Universität Berlin and partner institutions) funded by the German Research Foundation (DFG).

In Europe, Wageningen University & Research is identified by the IGZ as a prime partner. Accordingly, contacts have been increased in the reporting period.

Collaboration with other domestic and international institutions

Within the reporting period, the IGZ acquired funding for projects with institutes from the Leibniz Association, e.g. ATB, ZALF, ZMT[4]. Additionally, with the German Institute for Human Nutrition (DIfE) IGZ has joined forces via the Joint Lab "PhaSe – Phytochemistry and biofunctionality of secondary plant metabolites", established in 2018.

The IGZ is co-chairing two Working Groups of the European Plant Science Organisation (EPSO), "Horticulture" and "Nutritional Security". In some large-scale projects, for example "Food*4*Future" and "DiControl", the IGZ has a leading role as initiator and coordinator, as it was recommended by the previous evaluation. The most recent projects funded on the international level include governmental and non-governmental organisations and companies, for example "SiEUGreen" (with NORDREGIO Århus Kommune, Beijing Agricultural Ecological Ideas Services Union, Hunan Hengkai Environmental Protection Science & Technology Investment Co. Ltd., China and 26 other partners) and "HG4RR" (with *Deutsche Welthungerhilfe* e.V., WorldVeg and 12 other partners). According to IGZ, 36% of all collaboration partners in projects are from industry.

Other collaborations and networks

Between 2016 and 2018, IGZ has received 38 scientific guests, out of which eleven stayed longer than three months. In the same period, 78 scientists from IGZ stayed at research institutes abroad, among them four who stayed for longer than three months.

IGZ participates in the Marie Skłodowska-Curie International Training Network "BestPass" where 12 European partners run a joint PhD programme with doctoral students located at each site.

5. Staff development and promotion of junior researchers

Staff development and personnel structure

At 31 December 2018, IGZ employed 96 people (85.24 FTE), 48 of whom were scientists, 42 working at service positions and six in the administration. Additionally, six student assistants, two trainees and three scholarship recipients worked at the institute. The overall number is distinctly lower compared to the 119 employed individuals in 2014 (last evaluation). This reflects the cut in core funding by one third of the original core budget following the loss of the Erfurt site, and in particular concerns the number of technical personnel that was reduced by 34%.

Due to the fact that IGZ acquired more grant funding and at present employs more scientists on grant funded positions than previously, the number of persons employed in research and scientific services (excluding scholarship recipients) did not decline. In consequence of the decreased core budget and higher income from grants, the proportion of permanent positions for scientific personnel decreased from 49% to 40%. IGZ states that at present it has 19 permanently employed scientists only. The institute considers this

[4] Leibniz Institute for Agricultural Engineering and Bioeconomy (ATB), Potsdam, Leibniz Centre for Agricultural Landscape Research (ZALF), Müncheberg, Leibniz Centre for Tropical Marine Research (ZMT), Bremen

number very low compared with its long-term strategic goals. Most scientists at IGZ are now on non-permanent contracts. The institute highlights that for technical personnel it strives for permanent positions wherever possible.

The new positions planned through to 2019 can be financed from the current IGZ budget due to restricted recruitment of personnel to new permanent positions in the past years, increasing flexibility in staffing. To strengthen rhizosphere research, IGZ aims for additional funding (Minor extraordinary item of expenditure of a scientific-strategic nature). In addition, IGZ faces some turnover in staff in the coming years. Several scientists will retire in the next years. To maintain and further improve academic excellence at IGZ in future, the institute has a medium-term plan for new leading research positions at IGZ.

The institute sees itself as an attractive employer. It states that, in general, the number and quality of applicants is high for both research and technical positions, with newly employed scientists at IGZ having a diverse study background such as biology, environmental sciences or nutritional sciences.

Promotion of gender equality

Of the total number of scientists at IGZ in 2018, 60% were women. In executive positions, three out of seven scientists and both junior group leaders were women (56%).

According to the institute, equal opportunities for women and men, and a balanced work-family-life are primary aspects of the IGZ policy. In 2013, the IGZ was successfully certified by the audit *berufundfamilie*. Currently, the IGZ is passing the consolidation process for the audit, and re-certification was received in March 2019.

Promotion of junior researchers

During the reporting period 2016-2018, 18 dissertations were successfully finished under the supervision of IGZ staff, including four dissertations by PhD students not employed at the institution. In December 2018, IGZ hosted 15 doctoral candidates (twelve with an employment contract).

PhD students are affiliated with different universities. Most of the PhDs and post-doctoral researchers are involved in third-party funded projects. They have access to seminars and courses as part of the respective programmes and graduate schools at their universities and other partner universities of the IGZ. Additionally, the IGZ offers e.g. a weekly student progress seminar and complementary skills training workshops.

Doctoral candidates sign a PhD agreement with the IGZ, which includes the rights and responsibilities of both parties. Under this agreement, each PhD student is supported by two co-mentors, of whom at least one must be a scientist at the institute. This group discusses the working plan and the progress of the PhD project regularly.

Vocational training for non-academic staff

IGZ offers apprenticeship positions for a biological technician, a chemical technician, and a plant technologist. After the loss of funding for the Erfurt site, the institute currently has only two places for apprentices.

IGZ gives high priority to vocational training of non-academic staff and therefore established a training fund of 59 K€ in 2018. Between 2016 and 2018, a total of 102 staff took part in vocational training measures compared to 85 between 2012 and 2014.

6. Quality assurance

Internal quality management

In order to assure overall research quality, the IGZ has implemented several quality assurance measures within the Programme Areas, including regular group meetings and methodology seminars. New topics and projects are adopted according to suggestions of the General Assembly, the Science Advisory Board (SAB) or of IGZ scientists on all levels, subsequently discussed in the Programme Areas and finally adopted by the Executive Board. IGZ also incorporates demands and recommendations for research topics expressed by horticultural practice.

Compared to the previous matrix system, IGZ now has a less complex structure as recommended by the 2015 evaluators. Accordingly, the PA heads and the IGZ Executive Board monitor research results regularly. Results are discussed with the SAB of the IGZ and adjustments are made as needed. In 2017, the new research structure and a new research programme were implemented, the work of several groups was terminated and the distribution of the staff among the Programme Areas was adjusted. In addition, more staff was employed in science management.

Scientists at IGZ are encouraged to publish their research results in peer-reviewed, worldwide accessible scientific journals. The institute applies a performance-based allocation of resources.

Quality management by the Scientific Advisory Board and Supervisory Board

IGZ states that the Science Advisory Board has shown a very active interest in the IGZ, and has taken valuable time to support the institute in the restructuring process. The SAB had in total 10 meetings (five full meetings and five consultations on selected issues) in the period of 2016-2018 with high attendance at each meeting.

Due to the shortened four-year funding period for the IGZ following the 2015 evaluation, no audit by the SAB has taken place since 2015. Instead, the SAB advised the institute on how to manage the closure of the IGZ Erfurt site, on the re-organisation of the institute, and in the new lead staff appointments that were made.

Implementation of recommendations from the last external evaluation

The IGZ responded to the central recommendations made by the Senate of the Leibniz Association in the last evaluation (highlighted here in italics, see also Statement of the Senate of the Leibniz Association from 17 March 2016).

1. *IGZ must re-engineer the composition and thematic focus of its work units with the aim of improving the coherence of the research programme and reinforcing strong areas. It is recognised that the institute has already undertaken the first major steps in this direction*.

IGZ lost joint funding for its Erfurt site in 2017, and consequently had to dismiss a large number of employees. IGZ received a core budget cut by one third. This was not foreseen in the evaluation report, but was recommended by the Senate of the Leibniz Association.

Executive Board and Research Staff Assembly revised the research programme of the IGZ in dialogue with the Science Advisory Board. According to the recommendations of the last evaluation, the work of some groups was terminated, the distribution of the staff among the Programme Areas was adjusted, and the matrix structure was suspended. The new research programme with four Programme Areas and ten Research Groups has been in place since January 1, 2017.

2. *In order to achieve greater international visibility IGZ should continue to improve the scientific basis of its research work. Thanks to its resources and infrastructural potential the preconditions for doing so are very good.*

For measures taken to strengthen the scientific base of the research and to increase the international visibility of the institute (new appointments, strategic partnerships) see Chapter 2 (Development of the institution and recommendation 3 below).

3. *IGZ conducts application-related basic research with the aim of creating and improving the scientific fundamentals of horticulture. To be successful also in the future, though, the institute must achieve a better balance between fundamental research and applied, practice-related research. In particular, IGZ has to further widen the scope of its research approaches by including questions, methods and techniques of molecular biology, as well as by identifying and addressing the big questions in the field. This should also include taking a leadership role in initiating new coordinated research efforts with national and international partners.*

As part of the development of the new research programme, the focus on fundamental sciences was intensified without losing track of applied research. Molecular techniques are now used in many of the current projects of the IGZ and are becoming routine tools in its research.

The IGZ is engaged in a number of projects and initiatives where it also plays a leading role. Examples include e.g.: the national "DiControl" project, Marie Skłodowska-Curie International Training Network "BestPass" and "Food*4*Future" (BMBF programme "Agrarsysteme der Zukunft").

4. *The institute should continue to publish results that are of relevance to practice in journals with a focus on applications. Future publication efforts must increasingly target peer-reviewed journals with an international reputation. This has to be embedded in an appropriate publication strategy.*

See Chapter 2 (Results)

5. *The establishment of a new professorship for "Biodiversity and Sustainability", which is planned as a joint appointment with Freie Universität Berlin, should be given very high priority. It would substantially reinforce IGZ's portfolio in an important area and would also be of strategic importance because cooperation with FU Berlin would mean gaining a strong collaborative partner. In order to finance this measure (joint appointment with two scientists as complementary staff) IGZ intends to apply for additional funds from Federal and Länder Governments in the context of a "minor*

extraordinary item of expenditure of a scientific-strategic nature". These plans are explicitly endorsed.

Although plans for this new professorship were explicitly endorsed by the evaluators, the Senate of the Leibniz Association later decided that IGZ has to delay the realisation of these plans. Accordingly, the joint appointment with FU Berlin on "Biodiversity and Sustainability" has not been realised. It now has high priority in view of the IGZ; the IGZ intends therefore to apply for the corresponding "minor extraordinary item of expenditure of a scientific-strategic nature".

6. *Furthermore, IGZ intends to apply for additional funding for a joint professorship entitled "Development Economics in Horticulture". This action is not endorsed: against the backdrop of more pressing tasks, it is not meaningful at this stage to introduce a completely new, likely isolated discipline such as Development Economics at IGZ.*

The Leader of the Research Group "Economic development and food security" successfully applied for third-party funding based on an agenda around horticulture, food security and human behaviour.

7. *At an average of 1 million € and 10.4 per cent of the revenue in 2012-2014, third-party funding remains too low. This situation must now change for the better. IGZ must raise significantly more funding from the DFG, in particular.*

See Chapter 2 (Appropriateness of funding). A new position in the Science Management Team was created for supporting the submission of proposals for third-party funding.

Since the 2015 evaluation, scientists have participated in several DFG programmes (see Chapter 2, Appropriateness of facilities, equipment and staffing). This includes a successful acquisition of funding under the Collaborative Research Centre (Sonderforschungsbereich, SFB) programme. A post-doctoral researcher acquired DFG funding for her own position. The selection criteria for new joint appointments at IGZ include the potential for taking on leadership in DFG-funded consortia.

8. *The substantial investments in IGZ's facilities should produce a significantly enhanced scientific performance in the future. It is expected that the excellent infrastructure will be utilised to target the acquisition of third-party projects involving high-level external collaborative partners.*

According to IGZ, the excellent infrastructure has been maintained and even further improved within the limits of the decreased core budget. For example, the infrastructure in metabolomics with its focus on the analysis of plant secondary metabolites, together with the new W2 professorship on "Analytical Food Chemistry of Secondary Plant Metabolites" was an essential factor in a number of successful applications for third-party funding.

Recruitment of the new Leader of RG HORTSYS.2 after an international selection procedure has supported the utilisation of the new gas-exchange greenhouse as an important infrastructure nationally and in the European context.

IGZ states that high-level external collaborative partners such as at Wageningen University & Research are more involved in IGZ research than before, but collaboration with other distinguished external partners has to be increased in the near future.

9. *In expanding its national and international collaborations, IGZ should increasingly take account of strategic considerations. In particular, it should identify distinguished institutions which would be appropriate partners in conducting joint third-party projects.*

The institute states that in Europe, the Wageningen University & Research is a particularly distinguished partner of IGZ; collaboration with other distinguished institutions such as the John Innes Centre or UK universities will be pursued in the near future. Existing collaboration with US institutions is reflected by 11 joint publications in the period of 2016-2018. The Executive Board of IGZ has announced financial support for work periods in the US to all IGZ scientists. It was pleased to see that three scientists and one technician indeed resided at US universities for extended work periods. Such exchange of personnel will be increased in future. In addition, a workshop on IGZ collaboration with US scientists will be organised in 2019.

As an example for successful international collaboration on development-orientated research IGZ sees a research project funded by the WorldVeg/BMGF (Bill & Melinda Gates Foundation) that began in PA QUALITY during 2018.

10. *IGZ is called upon to use the usual competitive procedures for all the positions to be filled in the coming years.*

According to the institute, all IGZ positions are advertised, and there is always a competitive procedure and international experience is considered.

11. *It is recommended to increase the number of highly-qualified postdoctoral junior researchers by establishing third-party funded junior research groups, for example under the DFG's Emmy Noether Programme, or by introducing junior professorships.*

A third-party funded Junior Research Group (QUALITY.1.2) won support through the "Leibniz Best Minds" competitive funding programme. A former IGZ junior professor is now Leader of QUALITY.2 and has been jointly appointed with Universität Potsdam to a W2 professorship. Recently, she turned down an offer from Universität Göttingen for a W2 professorship. A new junior professorship will be established at IGZ as soon as a sufficient budget for IGZ can be secured. The IGZ has not yet been able to successfully attract a person funded by the DFG's Emmy Noether Programme, but sees this as a clear goal for the institute in the coming years.

12. *At IGZ, the advisory and steering mechanisms used for quality assurance must become more effective. It is recommended to simplify IGZ's management structures and introduce a clearer allocation of responsibilities.*

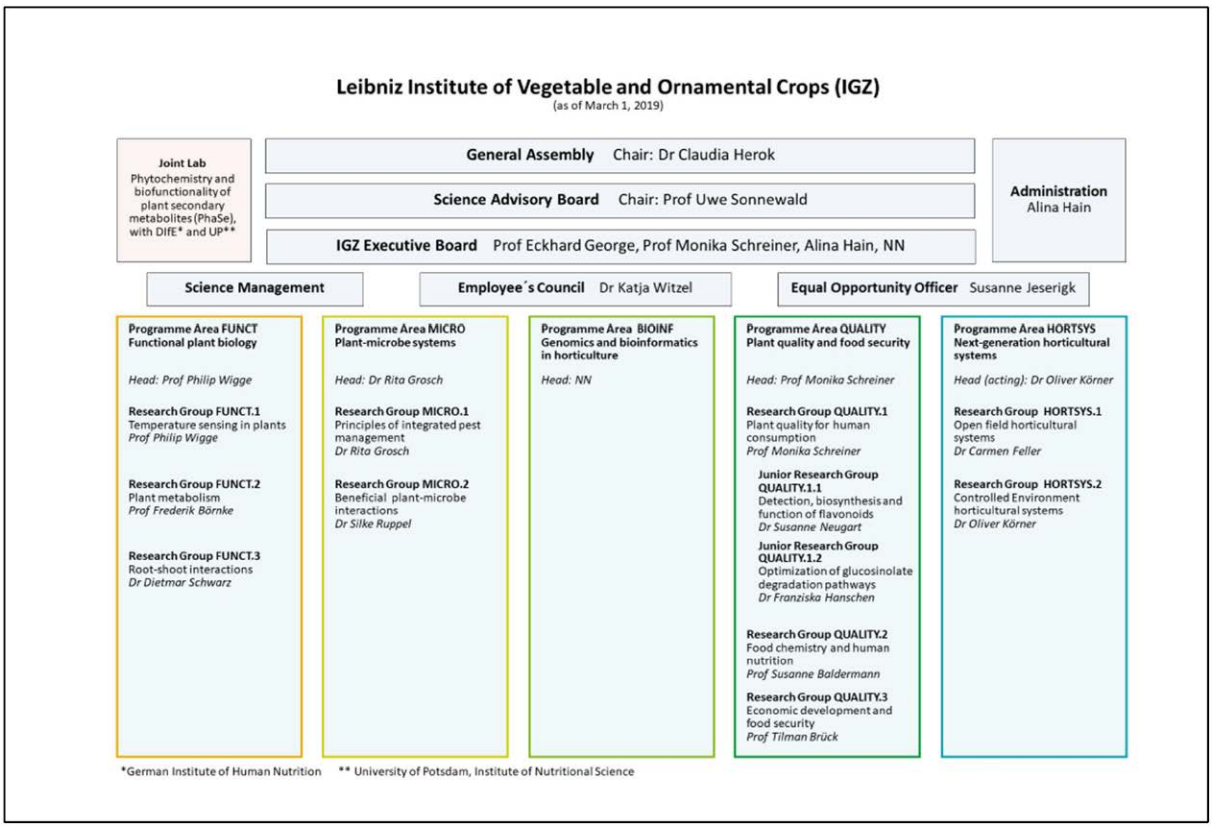
The matrix structure that was used in the IGZ since 2000 was suspended following the advice of the evaluators and replaced by a more hierarchical organisation with four (in 2019: five) Programme Areas with two to three Research Groups each. The PA heads took over the responsibility for quality assurance. This resulted in a less complex management structure and in a clearer assignment of responsibilities. The PA heads meet monthly with the Executive Board to ensure horizontal and vertical flow of information.

13 In accordance with the rules governing the Leibniz Association, the Federal Government must have the same number of votes on the Supervisory Board as the responsible Länder.

The new IGZ statutes follow this recommendation.

Appendix 1

Organisational chart



Appendix 2

Publications[1]

Type of publication	2016		2017	2018
	EF*+GB**	GB	GB	GB
Total number of publications	**129**	**111**	**145**	**160 (+26)**
Monographs	10	6	6	6
Individual contributions to edited volumes	48	41	61	73 (+1)
Articles in peer-reviewed journals	51	44	53	67 (+23)
Articles in other journals	20	20	20	10
Working and discussion papers	not counted	not counted	2	2
Editorship of edited volumes	0	0	3	2 (+2)

[1] Contributions that have been accepted for publication but not yet appeared/online first publication are added in parenthesis.
*EF: Erfurt site
**GB: Großbeeren site

Appendix 3 Revenue and expenditure

Revenue		2016			2017			2018		
		K€	%	%	K€	%	%	K€	%	%
Total revenue (sum of I., II. and III.; excluding DFG fees)		12.617			9.030			10.135		
I.	**Revenue (sum of I.1., I.2. and I.3)**	11.818	100 %		8.661	100 %		8.956	100 %	
1.	Institutional funding (excluding construction projects and acquisition of property)	10.593	90		7.541	87		7.649	85	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and *Länder* governments according to AV-WGL	10.593			7.541			7.649		
1.2	Institutional funding (excluding construction projects and acquisition of property) not received in accordance with AV-WGL									
2.	Revenue from project grants	1.225	10	100 %	1.120	13	100 %	1.307	15	100 %
2.1	DFG	138		11	160		14	174		13
2.2	Leibniz Association (competitive procedure)							46		4
2.3	Federal, *Länder* governments	990		81	898		80	897		69
2.4	EU							145		11
2.5	Industry	39		3						
2.6	Foundations									
2.7	*FAO, University*	58		5	62		6	45		3
3.	Revenue from services									
3.1	Revenue from commissioned work									
3.2	Revenue from publications									
3.3	Revenue from exploitation of intellectual property for which the institution holds industrial property rights (patents, utility models etc.)									
3.4	Revenue from exploitation of intellectual property without industrial property rights									
II.	**Miscellaneous revenue** (e.g. membership fees, donations, rental income, funds drawn from reserves)	799			369			1.179		
III.	**Revenue for construction projects** (institutional funding by Federal and *Länder* governments, EU structural funds, etc.)									

Expenditures		**K€**	**K€**	**K€**
Expenditures (excluding DFG fees)		**12.617**	**9.030**	**10.135**
1.	Personnel	7.299	4.877	5.579
2.	Material expenses	3.238	2.401	2.668
3.	Equipment investments	941	547	821
4.	Construction projects, acquisition of property			
5.	Cash resources	1.139	1.205	1.037
DFG fees (if paid for the institution – 2.5% of revenue from institutional funding)		263	187	190

Appendix 4

Staff at the institution - financing (as of: 31.12.2018).

	Full-time equivalents		Employees		Female employees	
	Total	on third-party funding	Total	on temporary contracts	Total	on temporary contracts
	Number	Percent	Number	Percent	Number	Percent
Research and scientific services	**40.87**	27.61	**48**	60.42	**29**	65.50
Professors / Direct. (C4, W3 or equivalent)	0	0	0	0	0	0
Professors / Direct. (C3, W2, 15Ü or equi.)	5	0	5	0	2	0
Academic staff in executive positions (A15, A16, E15 or equivalent)	2	0	2	0	1	0
Junior research group leaders / junior professors/ post-doctoral fellows (C1, W1, A14, E14 or equivalent)	2	30	2	50	2	50
Scientists in non-executive positions (A13, A14, E13, E14 or equivalent)	23.67	28.07	27	59.26	15	60
Doctoral candidates (A13, E13, E13/2 or equi.)	8.20	49.27	12	100	9	100
Service positions	**38.62**	1.94	**42**			
Laboratory (E9 to E12,upper-mid-level service)	10.75	6.98	12			
Laboratory (E5 to E8, mid-level service)	8.18	0	9			
Gardener (E9 to E12, upper-mid-level service)	2	0	2			
Gardener (E5 to E8, mid-level service)	6	0	6			
Workshops (E5 to E8, mid-level service)	2	0	2			
Equal Opportunities Officer	0,2	0	1			
Public Relations (E9 to E12, upper-mid-level service)	1	0	1			
Information Technology – IT (E13, E14, senior service)	1	0	1			
Information Technology - IT (E9 to E12, upper-mid-level service)	1	0	1			
Science Coordination (E13, E14, senior service)	1.75	0	2			
Science Coordination (E9 to E12, upper-mid-level service)	0.75	0	1			
Technical (large equipment, service) (E9 to E12, upper-mid-level service)	3	0	3			
Secretariat (E5 to E8, mid-level service)	1	0	1			
Administration	**5.75**	0	**6**			
Head of Administration	1	0	1			
Internal administration (financial administration, personnel etc.) (E5 to E8, mid-level service)	2	0	2			
Internal administration (financial administration, personell etc.) (E9 to E12, upper-mid-level service)	2	0	2			
Building service (E1 to E4)	0.75	0	1			
Student assistants	**1.5**	66.67	**6**			
Trainees	**2**	0	**2**			
Scholarship recipients at the institution	**3**		**3**		**2**	
Doctoral candidates	3	0	3		2	
Post-doctoral researchers	0	0	0		0	

14 January 2020

Annex B: Evaluation Report

Leibniz Institute of Vegetable and Ornamental Crops (IGZ) e. V., Großbeeren

Contents

1. Summary and main recommendations

IGZ conducts fundamental plant research with the aim of improving both the quality and quantity of horticultural products, especially vegetables. The institute conducts research into plant adaptation to the environment, interaction between plants and microbes (beneficial and pathogenic), plant quality and genotypic diversity of plants. IGZ develops sustainable production systems in horticulture and seeks to embrace economic and social scientific perspectives.

IGZ was last evaluated in 2016. At the time, the institute maintained two sites. Whilst work in Großbeeren was judged to be worthy of funding, the Leibniz Association Senate considered Erfurt to be underperforming. The Senate recommended ceasing joint funding for this site. After a period of four years, an assessment was to be undertaken to determine how the institute had developed under the altered general conditions. The Federal and *Länder* Governments decided according to these recommendations.

Due to these decisions, IGZ's institutional funding fell considerably (from EUR 10.6 m in 2016 to EUR 7.5 m in 2017) and the institute had to close the Erfurt site. The IGZ leadership mastered the extremely difficult tasks this involved very well. Closing the site tied up considerable energies. Nevertheless, with the support of the dedicated Scientific Advisory Board and the Supervisory Board, the leadership managed to initiate IGZ's restructuring. As was to be expected, these processes have by no means been completed as yet.

It can already be seen, however, that concentrating IGZ at Großbeeren was a wise move. In comparison with the previous situation, the institute has re-adjusted the balance between fundamental and applied research. At the last evaluation it was precisely in this respect that the earlier, cross-location based working units had not proved convincing. They were consequently wound up and replaced by a new organisational structure. The current division into four Programme Areas is meaningful and a significant improvement. The areas are, however, still under construction at present and are evaluated as "good to very good" in one case and as "good" in three cases. It is necessary that they will realise their full potential as soon as the current staffing changes in many executive positions have been completed and new appointments have had a chance to take effect.

In this respect it is very positive that since the last evaluation IGZ has continued to develop its staffing policy with regard to joint appointments of leading scientific staff together with the University of Potsdam and Humboldt-Universität zu Berlin. In 2015, only three of IGZ's senior scientists held W2 professorships, including the Director, and there was one W1 junior professorship. In the course of reorganisation, IGZ has established two W3 professorships (one appointed in 2019 in "Plant Nutritional Genomics", one subject to ongoing appointment procedures in "Genomics and bioinformatics in horticulture"). By 2023, further executive positions are scheduled to be transformed into professorships so that there will be a total of eight joint appointments at the institute. This increase in the number of professorships will be financed from existing institutional funding by converting positions.

Special consideration should be given to the following main recommendations in the evaluation report (highlighted in **bold face** in the text):

General concept

1. In comparison with the situation that was assessed as extremely critical four years ago, IGZ has strengthened fundamental research, as expected. IGZ conducts research into the properties of horticultural products, such as nutrient content, resilience to various environmental changes (e.g. temperature), nutrient utilisation efficiency (fertiliser, water), pathogen resistance, aroma and taste. The institute must now, as planned, continue along this path to the analysis of regulatory mechanisms, especially on the genetic level. The requisite methodological knowledge is now available at the institute and should be widely utilised.
2. It fits very well with IGZ's scientific objective that in a few months, a fifth Programme Area will be established in the promising field of "Genomics and Bioinformatics in Horticulture", headed by a W3 professor. A share of institutional funding has already been earmarked for the purpose. Further plans to use additional institutional funding to strengthen rhizosphere research should not be pursued at present.
3. The five joint appointments envisaged by 2023, including the appointment of a new Director, must be very carefully coordinated with the partner universities as well as with the strategic development of IGZ. The Scientific Advisory Board and the Supervisory Board should provide substantial support for these procedures, as they have done so far, and also draw on international expertise.

Results

4. In recent years, more publications in peer-reviewed journals have been produced by the Großbeeren site than previously by both sites together. Its publication record must, however, continue to improve significantly. In order to realise the institute's potential, and in view of the current generational change in many leadership positions, a binding publication strategy should be determined stating which internationally reviewed journals should be the priority publication destination for new scientific results and what expectations should be fulfilled with regard to publishing in practice-related journals.
5. IGZ has excellent scientific infrastructures (greenhouses, field experimental area and especially a phytotron with a gas-exchange greenhouse). The inherent methodological potential for the institute's own projects and, in particular, for joint undertakings with partner institutions must be exploited better. IGZ should consider whether it would be meaningful to pool the research infrastructures in an independent, and thus internally and externally more visible, core facility.

Appropriateness of facilities, equipment, and staffing

6. Since the last evaluation, third-party income has risen by just over two percentage points but, at 12.6 percent of overall income, is still too low. In the future, the third-party portfolio should be more diversified. The proportion of DFG funding, in particular, must be increased.

Subdivisions

7. The work in the field of development economics must now be much more closely integrated into the institute's overall activities. This is still a challenge. Recently, however, promising projects have been acquired that facilitate an alignment with horticultural value chains and eating habits. Overall, the group should intensify collaborations with partner institutions in the field.

Quality Assurance

8. The intended increase in the number of members as well as the impending changes should allow the Scientific Advisory Board to become even more international and reflect the broad spectrum of modern horticultural research.
9. It is very good that fundamental research has now been more firmly anchored in IGZ's statutes as the purpose of the institute. The specialist expertise on the Supervisory Board should be aligned accordingly.

2. General concept and profile

Development of the institution since the last evaluation

I.

IGZ was last evaluated in 2016. At the time, the institute maintained two sites. Whilst work in Großbeeren was judged to be worthy of funding, the Leibniz Association Senate considered Erfurt to be underperforming. The Senate recommended ceasing joint funding for this site. After a period of four years, an assessment was to be undertaken to determine how the institute had developed under the altered general conditions. The Federal and *Länder* Governments decided according to these recommendations.

Due to these decisions, IGZ's institutional funding fell considerably (from EUR 10.6 m in 2016 to EUR 7.5 m in 2017) and the institute had to close the Erfurt site. The IGZ leadership mastered the extremely difficult tasks this involved very well. Closing the site tied up considerable energies. Nevertheless, with the support of the dedicated Scientific Advisory Board and the Supervisory Board, the leadership managed to initiate IGZ's restructuring. As was to be expected, these processes have by no means been completed as yet.

It can already be seen, however, that concentrating IGZ at Großbeeren was a wise move. In comparison with the previous situation, the institute has re-adjusted the balance between fundamental and applied research. This has had a positive impact on the institute's scientific policy and has led to a convincing new organisational structure which now need to take full effect.

II.

IGZ conducts fundamental plant research with the aim of improving both the quality and quantity of horticultural products, especially vegetables. The institute develops sustainable production systems in horticulture and seeks to embrace economic and social scientific perspectives. **In comparison with the situation that was assessed as extremely critical four years ago, IGZ has strengthened fundamental research, as**

expected. IGZ conducts research into the properties of horticultural products, such as nutrient content, resilience to various environmental changes (e.g. temperature), nutrient utilisation efficiency (fertiliser, water), pathogen resistance, aroma and taste. The institute must now, as planned, continue along this path to the analysis of regulatory mechanisms, especially on the genetic level. The requisite methodological knowledge is now available at the institute and should be widely utilised.

Plant science has a major impact on global food production and security, nutritional behaviour and economic development, especially in the countries of the Global South. Against this backdrop, shortly before the last evaluation, IGZ began targeting issues of development economics. In the light of the last evaluation and its impact on core funding it was the right decision to invest limited resources from IGZ's core budget and to rely mainly on third-party funding for these new topics. The inclusion of development economics in the institute's overall activities is still a challenge (see Chapter 3: PA QUALITY).

III.

Organisationally, the previous cross-location based working units did not prove convincing at the last evaluation. Fundamental and applied research were not well balanced. When closing the site in Erfurt, these working units were dissolved and replaced by a new organisational structure.

The current division into four Programme Areas with two to three research groups each is meaningful and constitute a significant improvement. The areas are, however, still under construction at present. It is to be expected that they will realise their full potential as soon as the current staffing changes in many executive positions have been completed.

Strategic work planning for the next few years

It fits very well with IGZ's scientific objective that in a few months, a fifth Programme Area will be established in the promising field of "Genomics and Bioinformatics in Horticulture", headed by a W3 professor. A share of institutional funding has already been earmarked for the purpose. Further plans to use additional institutional funding to strengthen rhizosphere research should not be pursued at present. A new leadership might revisit the concept.

It is very positive that, since the last evaluation, IGZ has continued to develop its staffing policy with regard to joint appointments of senior scientific staff together with the University of Potsdam and Humboldt-Universität zu Berlin. In 2015, only three of IGZ's senior scientists held W2 professorships, including the Director, and there was one W1 junior professorship. According to its own planning, by 2023, IGZ will have eight joint W3 and W2 professorships which will be established in the framework of existing institutional funding.

Specifically: In 2018, one additional W2 professorship was established in "Analytical Food Chemistry of Secondary Plant Metabolites" for a W1 junior professor in order to keep her from accepting another institution's call. In 2019, a newly created W3 professorship was filled in "Plant Nutritional Genomics" with a researcher who had previously been working

in Cambridge, UK. The appointment of a further W3 professor to head the planned fifth Programme Area is nearing completion (see above). In 2020, a recently vacated W2 professorship will be refilled and the first head of Programme Area 4 will also be appointed to a W2 position. In 2022, there will be a new appointment to the position of Director (currently W2). Finally, in 2023, the head of Programme Area 3 will retire and be replaced by a W2 professor.

The five joint appointments envisaged by 2023, including the appointment of a new Director, must be very carefully coordinated with the partner universities as well as with the strategic development of IGZ. The Scientific Advisory Board and the Supervisory Board should provide substantial support for these procedures, as they have done so far, and also draw on international expertise.

Results

In recent years, more publications in peer-reviewed journals have been produced by the Großbeeren site than previously by both sites together. Its publication record must, however, continue to improve significantly. In order to realise the institute's potential, and in view of the current generational change in many leadership positions, a binding publication strategy should be determined stating which internationally reviewed journals should be the priority publication destination for new scientific results and what expectations should be fulfilled with regard to publishing in practice-related journals.

By publishing in practice-related journals, IGZ makes an important contribution to knowledge transfer. Staff at the institute also work on various expert and consultative committees. The institute advises, for example, the Federal Ministry of Food and Agriculture (BMEL) on the appropriate use of fertilisers. Via its involvement in the European Plant Science Organisation (EPSO), IGZ also contributes to statements on new plant breeding methods and the corresponding European and German legislation. Thanks to a number of collaborative projects, IGZ maintains links to horticultural practice and industry.

IGZ has excellent scientific infrastructures (greenhouses, field experimental area and especially a phytotron with a gas-exchange greenhouse). The inherent methodological potential for the institute's own projects and, in particular, also for joint undertakings with partner institutions must be exploited better. IGZ should consider whether it would be meaningful to pool the research infrastructures in an independent, and thus internally and externally more visible, core facility.

Appropriateness of facilities, equipment, and staffing

Since the last evaluation, IGZ's institutional funding has dropped by the sum foreseen for the part of the institute formerly located in Erfurt. Funding fell by approximately 30 percent (from EUR 10.6 m in 2016 to EUR 7.5 m in 2017). The funding is appropriate for the current range of tasks undertaken by IGZ in Großbeeren. Against the backdrop of the ongoing staffing changes, the institute transfers comparatively high revenues forward from

the previous years to the following year ("überjährig verfügbare Selbstbewirtschaftungsmittel"). It is expected that this will be reduced by the establishment of the fifth Programme Area and the appointments to the currently vacant leadership positions.

Since the last evaluation, third-party income has risen by just over two percentage points but, at 12.6 percent of overall income, is still too low. In the future, the third-party portfolio should be more diversified. The proportion of DFG funding, in particular, must be increased. At present, project funding from the Federation (including BMBF and BMEL) is uppermost. Whilst IGZ has been able to double the amount of funding acquired from the DFG and funding is also approaching the level of DFG fees, the latter are still not being completely recouped. It should also be noted that a CRC project billed via FU Berlin has not been included.

IGZ's infrastructure is excellent (see above). Given the additional requirements associated with the establishment of the new Programme Area "Genomics and bioinformatics in horticulture", its IT equipment should be further enhanced. As planned, IT support should also be stocked up in the process.

The institute sees a need for a new multipurpose building that would provide space for the expanding Programme Area "Functional plant biology" and the new Programme Area "Genomics and bioinformatics in horticulture". The Review Board endorses this space requirement.

3. Subdivisions of IGZ

3.1 Programme Area "Functional plant biology" (8.5 FTE, thereof 6.1 FTE research and 2.4 FTE service staff)

The Programme Area "Functional plant biology" seeks to identify and characterise the genes and networks that enable environmental adaptation in plants, particularly those relevant to horticultural plants. The Programme Area was formed in 2017 and is currently still under construction. It comprises three groups.

RG Plant metabolism (4.1 FTE research) aims to gain knowledge about transcriptional and translational networks enabling plants to respond appropriately to changing environmental conditions. It is headed by a professor who holds a joint appointment at the University of Potsdam and has established molecular biology at the institute. RG Root-shoot interactions (1 FTE research) is led by an acknowledged grafting expert. He thus focuses on application-oriented work on enhancing informed selection of rootstock/scion combinations in order to minimise the negative effects of transplantation on quality. Since mid-2018, this Programme Area has been very well complemented by RG Temperature sensing in plants (1 FTE research) which seeks to identify the underlying mechanisms of temperature perception in order to breed climate resilient crops.

The Programme Area pursues a coherent concept that convincingly combines basic research with applications. This expertise in applications should remain in the Programme Area when the head of root-shoot interactions retires. The Programme Area produces very good research results which, however, should be published more frequently in

higher ranking journals. Third-party income has also been too low in recent years and should be increased. It is very positive that the Programme Area has managed to acquire DFG funding and is involved in a Collaborative Research Centre at FU Berlin.

The Programme Area "Functional plant biology" is currently rated as "good to very good". The preconditions for enhancing this performance in the coming years are extremely promising, not least because the head of RG Temperature sensing in plants, who holds a joint appointment at the University of Potsdam and was recruited to head the Programme Area in January 2019, is a distinguished scientist with vast international experience. With his expertise, he has brought the institute immense potential for driving its overall development.

3.2 Programme Area "Plant-microbe systems" (19.6 FTE, thereof 14.1 FTE research and 5.5 FTE service staff)

The Programme Area "Plant-microbe systems" does research on the interaction between plants, microbes and the environment with regard to sustainable cultivation systems in horticulture. It is thus thematically very well positioned: in a field of huge promise it addresses important, topical issues. The Programme Area comprises two groups: RG Principles of integrated pest management (8.8. FTE research) focuses on particular plant defence processes against root pathogens. RG Beneficial plant-microbe interactions (5.3 FTE research) analyses plant-microbe interactions in order to apply microbes in horticultural production systems.

Using 'omics' technologies, bioinformatics, molecular biology, phenotyping, and modelling the two groups investigate the whole complexity of the microbiome. They produce interesting scientific results which, however, must be published in higher-ranking journals. The Programme Area raises third-party funding from the Federal and *Länder* Governments, and to a lesser extent from the EU. In the future, it should try to acquire DFG funding by contributing, for instance, to the thematically relevant priority programmes.

The Programme Area "Plant-microbe systems" is currently rated as "good". It has great potential and will benefit from cooperation with the future Programme Area "Genomics and bioinformatics in horticulture" (see Chapter 2). A senior scientist who had been jointly appointed with HU Berlin, has moved to the newly founded research centre in Erfurt and now holds a professorship at the University of Jena (see Chapter 4). A distinguished researcher with international experience who can drive the development of the Programme Area should be recruited as a successor.

3.3 Programme Area "Plant quality and food security" (20.2 FTE, thereof 13.3 FTE research and 6.9 FTE service staff]

The Programme Area "Plant quality and food security" is composed of two life science-oriented research groups, which work on plant secondary metabolites, and a social science-oriented research group that aims to address the role of plant quality for farm production and human consumption from a development and agricultural economics perspective.

The two life science-oriented Research Groups, RG "Plant quality for human consumption" (9 FTE research) and RG "Food chemistry and human nutrition" (2.2 FTE research), investigate how plant substances contribute to food nutritional quality. They are complemented by very promising junior research groups that receive funding from the DFG as well as through the Leibniz Competition. The groups have established a state-of-the-art analytical platform that now has to be fully exploited. They use sound technical approaches and produce good research results. The groups must now exploit the considerable potential of the topics by testing the hypotheses using genetic research approaches. This will enable them to publish at a higher level.

Shortly before the last evaluation, IGZ decided to introduce the perspective of development economics into the institute's portfolio (see Chapter 2) and engaged a scientist with high-level expertise in the field. The RG "Economic development and food security" (2.1 FTE research) he heads is essentially third-party funded. The group publishes very well. **The work must now be much more closely integrated into the institute's overall activities. This is still a challenge. Recently, however, promising projects have been acquired that facilitate an alignment with horticultural value chains and eating habits. Overall, the group should intensify collaborations with partner institutions in the field.**

The Programme Area "Plant quality and food security" is rated as "good". It acquires extensive third-party funding from the Federal and *Länder* Governments and produces successful junior researchers who obtain attractive positions. The head of RG "Food chemistry and human nutrition", a former junior professor, was appointed to a W2-professorship in 2017. Current activities are strongly determined by the BMBF-funded collaborative project „Food*4*Future" (see Chapter 4). The Programme Area must, however, pursue more curiosity driven research. Cooperation with the German Institute for Human Nutrition (DIfE) in a newly established Joint Lab (see Chapter 4) holds great potential. The forthcoming change in leadership in 2023 should lead to yet further improvement in scientific performance.

3.4 Programme Area "Next-generation horticultural systems" (14.8 FTE, thereof 9.7 FTE research and 5.1 FTE service staff)

The Programme Area "Next-generation horticultural systems" aims to develop innovative management strategies for the sustainable use of resources and for adaptation to climate change by using model-based decision support systems. The Programme Area is coherently organised with two sub-units addressing indoor and outdoor horticulture:

In 2017, units that had been rated as very strong in application related work at the last evaluation were amalgamated to form RG "Open field horticultural systems" (5.5 FTE research). The group is still very active in this area. It prepared, for example, several statements for the Federal Ministry of Food and Agriculture (BMEL) on the national directive on fertiliser use. Work is based on sensor techniques and the modelling of nutrient cycles and plant growth. To head RG "Controlled environment horticultural systems" (3.5

FTE research) IGZ recruited a recognised modeller in 2017; three additional group members followed in 2018. Their intention to combine the modelling of controlled environments technology and crop physiological processes is very promising.

The Programme Area addresses a number of interesting, forward-looking projects. At the same time, it functions as the central unit for translating basic scientific research results from the other Programme Areas into indoor and outdoor horticultural production systems. In addition to its research activities, the Programme Area is responsible for developing and maintaining IGZ's state-of-the-art research infrastructures. In the future, their inherent methodological potential must be exploited better. The institute should therefore consider whether it would be meaningful to pool the research infrastructures in an independent, and thus internally and externally more visible, core facility (see Chapter 2).

The Programme Area "Next-generation horticultural systems" is currently rated as "good". At the moment, it is being led by an acting head and is undergoing transformation. When the position is up for reappointment in 2020, the opportunity must be grasped to fill it with a reputed researcher.

4. Collaboration and networking

Collaboration with universities

IGZ collaborates with Humboldt-Universität zu Berlin and University of Potsdam. Links to the University of Potsdam have become significantly closer since the last evaluation, especially as a result of intensive planning for joint appointments (see Chapter 2).

The productive cooperation in the Berlin-Brandenburg Science Region is also demonstrated by the involvement of an IGZ scientist in the Collaborative Research Centre (CRC) "Priming and Memory of Organismic Responses to Stress" under the leadership of FU Berlin and also involving the University of Potsdam and the MPIMP (see below). The fact that an IGZ scientist is participating in the CRC as well as his affiliation to IGZ should, however, be made much clearer (amongst others on the CRC website) in order to enhance IGZ's visibility. In spring 2019, the Joint Lab "PhaSe – Phytochemistry and biofunctionality of secondary plant metabolites" was established in which IGZ will cooperate closely with the German Institute for Human Nutrition (DIfE) and the University of Potsdam.

Collaboration with other institutions

In addition to the Joint Lab, within the Leibniz Association, IGZ is successfully involved in four Leibniz Research Alliances and a Leibniz Network. It also cooperates in joint third-party projects with Leibniz institutions working in related areas (see Status Report, p. A-16).

In the framework of large-scale projects such as "Food*4*Future", financed by the Federal Ministry, IGZ cooperates with various institutions within and outside of the Leibniz Association. Special mention should be made of IGZ's various collaborations with project partners in industry. Apart from this, the institute works together with the "Forschungsstelle für Gartenbauliche Kulturpflanzen", a newly founded research centre at the

University of Applied Sciences in Erfurt which receives project funding from the Ministries of Agriculture in the Federation and *Land* Thüringen in order to continue certain activities conducted by IGZ's former site in Erfurt.

A particularly important collaboration from IGZ's point of view is the one with the Max Planck Institute of Molecular Plant Physiology (MPIMP). Cooperation here has been continuously intensified in recent years. The head of PA FUNCT is a member of the faculty at the International Max Planck Research School (IMPRS) "Primary Metabolism and Plant Growth" which is located there, and his PhD students are integrated in the school. It is to be expected that cooperation will be extended further when the fifth Programme Area "Genomics and bioinformatics in horticulture" is operational.

The institute's plans to cooperate more with Wageningen University are welcomed. Further steps towards internationalisation should be elaborated in connection with the overarching institutional strategy.

5. Staff development and promotion of junior researchers

Staff development and personnel structure

On 31 December 2018, IGZ employed 96 individuals (excluding student assistants, trainees and scholarship recipients, see Status Report, Annex 4): 48 worked in research and scientific services, 42 in services and six in administration. On the reporting date, IGZ thus employed 23 fewer individuals than it had four years ago. It is positive that, thanks to the increased acquisition of third-party funding, the number of scientists employed by the institute has now reached the same level as at the last evaluation.

The plans to appoint all future heads of Programme Areas to professorships in the framework of joint appointment procedures are extremely meaningful and are highly welcomed (see Chapter 2). From the Review Board's standpoint, however, it is not necessary to envisage additional professorships at the level of research groups as IGZ is currently considering.

Promotion of gender equality

At 60 percent, the proportion of women in research and scientific services is pleasingly high. On 31 December 2018, moreover, three of the seven executive positions (43%) were held by women whilst the heads of both junior research groups were also female (100%). Of the four currently existing professorships, however, only one is held by a woman. It is welcomed that, in accordance with the binding regulations set by the Federal and *Länder* Governments, target quotas have been introduced to increase the proportion of women at these levels. In the coming years, opportunities will be opened up in this regard.

IGZ has implemented meaningful measures to promote the reconciliation of family life and work. In 2019 it was successfully re-audited.

Promotion of junior researchers

At the end of December 2018, 15 doctoral candidates worked at the institute. In the three years 2016-2018, 14 dissertations were completed (as well as four that were externally

supervised). IGZ's doctoral candidates are well supervised by thesis committees. They are affiliated with different universities and their respective doctoral programmes which stipulate different requirements. IGZ's Graduate Student Programme should align itself with the highest of these requirements and accordingly have more mandatory elements.

Postdocs also enjoy very good conditions at the institute. There is still potential for enhancing performance. A mentoring programme should be introduced that should lead, above all, to greater internationalisation in postdocs' scientific and professional prospects. Researchers from abroad should be recruited as mentors. Tenure should be subject to a standardised procedure involving external expertise.

IGZ produces successful junior research group leaders, some of whose groups – as recommended at the last evaluation – are third-party funded (DFG position, Leibniz Competition). One junior research group leader has now assumed a professorship at the University of Göttingen. Following an offer from another university, a junior professor was appointed to a joint W2 professorship with the University of Potsdam.

Vocational training for non-academic staff

IGZ offers appropriate training and continuing education opportunities. In the future, annual staff appraisals should also be held with non-scientific staff.

6. Quality assurance

Internal quality management

Locating IGZ exclusively in Großbeeren facilitates institute management. The reworked organisational structure is appropriately designed and a significant improvement on the previous situation. A binding publication strategy should be instituted (see Chapter 2).

Quality management by the Scientific Advisory Board and Supervisory Board

In recent years, the Scientific Advisory Board has supported IGZ with exceptional dedication. It advised the institute extensively with regard to its scientific development. The board's expertise will be extremely important in chaperoning its continued development. **The intended increase in the number of members as well as the impending changes should allow the Scientific Advisory Board to become even more international and reflect the broad spectrum of modern horticultural research.**

The Supervisory Board also fulfils its statutory obligations appropriately and intensively supports IGZ's restructuring. Since the last evaluation, the association statutes have been aligned with the requirements for Leibniz institutions. The chair of the Scientific Advisory Board has the right to attend Supervisory Board meetings as a guest, and the Federation has the same number of votes as the *Land*. **It is very good that fundamental research has now been more firmly anchored in IGZ's statutes as the purpose of the institute. The specialist expertise on the Supervisory Board should be aligned accordingly.**

Implementation of recommendations from the last external evaluation

The following addresses the Senate's recommendations insofar as they refer to IGZ in Großbeeren (highlighted here in *italics*, see Statement of the Senate of the Leibniz Association of 17 March 2016):

1. *The Senate recommends to end funding for the Erfurt site.*

The Federal and *Länder* Governments implemented this recommendation. The institute had to close its site in Erfurt. The IGZ leadership mastered the extremely difficult tasks this involved very well. Closing the site tied up considerable energies. Nevertheless, with the support of the dedicated Scientific Advisory Board and the Supervisory Board, the leadership managed to initiate IGZ's restructuring. It can already be clearly seen that concentrating IGZ at Großbeeren was a wise move (see Chapter 2 and recommendation below).

2. *In order to achieve greater international visibility, IGZ must continue to improve the scientific basis of its application-related activities.*

In comparison with the previous situation, the institute has re-adjusted the balance between fundamental and application-related research. As was to be expected, the reorganisation that has been launched has by no means been completed as yet. A convincing course has, however, been set and new structures created which now need to be fleshed out (see Chapter 2 and recommendation above).

3. *In the future, there should be significantly more publications in peer-reviewed scientific journals. In order to implement this goal systematically, the institute is recommended to develop a publication strategy.*

In recent years, more publications in peer-reviewed journals have been produced by the Großbeeren site than previously by both sites together. IGZ's publication record must, however, continue to improve significantly and be instituted in a binding publication strategy stating which internationally reviewed journals should be the priority publication destination for new scientific results and what expectations should be fulfilled with regard to publishing in practice-related journals (see Chapter 2).

4. *There have been two joint appointments with the University of Potsdam whilst a further appointment is planned to fill the position of head of* Plant Nutrition *which has been vacant since the beginning of 2015. […] this is a top priority and must now be expedited.*

For the professorship in "Plant Nutritional Genomics" an excellent researcher with extensive international experience has been recruited to a joint appointment with the University of Potsdam. He has headed the PA FUNCT since January 2019 and was previously at the University of Cambridge (see Chapter 2).

5. *The establishment of a joint professorship in Biodiversity and Sustainability that IGZ is planning with Freie Universität Berlin should be shelved for the time being.*

As recommended, the plans for this joint professorship with FU Berlin have been shelved.

6. *Further thoughts about expansion should not be pursued.*

As recommended, the plans for an extraordinary item of expenditure for "Development economics in horticulture" have not been pursued; instead, the topic has largely been adopted with third-party funding. These activities must, however, be integrated better (see Chapter 2 and Chapter 3.3).

7. *Special mention should be made of the large-scale phytotron with integrated gas-exchange greenhouses which went into operation in 2014 and also received substantial funding from the EU. The Senate now expects this investment also to be utilised to target the acquisition of third-party projects with established international collaborative partners.*

IGZ's excellent scientific infrastructures must still be utilised yet more intensively. IGZ should consider whether it would be meaningful to pool the research infrastructures in an independent core facility (see Chapter 2).

8. *Since 2014, an upward trend in third-party funding has set in which must continue in the coming years.*

Third-party income has increased slightly since the last evaluation but is still too low. The third-party portfolio should be more diverse in the future. DFG funding, in particular, should be increased (see Chapter 2).

Appendix

1. Review board

Chair (Member of the Leibniz Senate Evaluation Committee)

Andreas P. M. **Weber**	Institute of Plant Biochemistry, Düsseldorf University

Deputy Chair (Member of the Leibniz Senate Evaluation Committee)

Annette G. **Beck-Sickinger**	Institute of Biochemistry, Leipzig University

Reviewers

Mark J. **Bailey**	Centre for Ecology & Hydrology, Wallingford (UK)
Inge **Broer**	Professor for Agrobiotechnology, University of Rostock
Natalia **Dudareva**	Department of Biochemistry and Department of Horticulture and Landscape Architecture, Purdue University, Indiana (USA)
Kevin M. **Folta**	Horticultural Sciences Department, University of Florida (USA)
Cathie **Martin**	Metabolic Biology Department, John Innes Centre, Norwich (UK)
Hans-Peter **Piepho**	Institute for Crop Science, Hohenheim University
Johannes **Sauer**	Chair of Agricultural Production and Resource Economics, Technical University of Munich
Paul **Schulze-Lefert**	Department of Plant Microbe Interactions, Max Planck Institute for Plant Breeding Research, Cologne

Representative of the Federal Government (Member of the Leibniz Senate Evaluation Committee)

absent with apologies	Federal Ministry of Education and Research, Bonn

Representative of the Länder *Governments (Member of the Leibniz Senate Evaluation Committee)*

Marc **Brüser**	Ministry of Science, Continuing Education and Culture of the Federal State of Rhineland-Palatinate, Mainz

4 February 2020

Annex C: Statement of the Institution on the Evaluation Report

Leibniz Institute of Vegetable and Ornamental Crops (IGZ) e. V., Großbeeren

We thank the members of the evaluation board for their constructive and thorough evaluation. We appreciate the acknowledgement that the institute has undergone a period of extensive reorganisation which has been challenging, but that the new structure for the institute positions us to consolidate our scientific programme with a strong basis in fundamental plant science, while recognising the importance of horticulture as a complex natural, environmental and social system. The evaluation document makes nine main recommendations. We are in full agreement with these recommendations. Here, we outline how they guide the development of our institute.

1. In comparison with the situation that was assessed as extremely critical four years ago, IGZ has strengthened fundamental research, as expected. IGZ conducts research into the properties of horticultural products, such as nutrient content, resilience to various environmental changes (e.g. temperature), nutrient utilisation efficiency (fertiliser, water), pathogen resistance, aroma and taste. The institute must now, as planned, continue along this path to the analysis of regulatory mechanisms, especially on the genetic level. The requisite methodological knowledge is now available at the institute and should be widely utilised.

We thank the evaluators for this positive assessment of our progress towards understanding genetic mechanisms. We have indeed proceeded with this transition since the visit of the evaluation panel. This goal will be further aided by the recruitment of the head of the fifth programme area in genomics and bioinformatics. Continuing rounds of new appointments at the Professor level will further accelerate this process.

2. It fits very well with IGZ's scientific objective that in a few months, a fifth Programme Area will be established in the promising field of "Genomics and Bioinformatics in Horticulture", headed by a W3 professor. A share of institutional funding has already been earmarked for the purpose. Further plans to use additional institutional funding to strengthen rhizosphere research should not be pursued at present.

We thank the evaluators for this support for our development. The W3 professorship selection process, coordinated by the University of Potsdam, is advanced and a call has been made in January 2020. We are looking forward to negotiate the start-up package for this group and programme area.

3. The five joint appointments envisaged by 2023, including the appointment of a new Director, must be very carefully coordinated with the partner universities as well as with the strategic development of IGZ. The Scientific Advisory Board and the Supervisory Board should provide substantial support for these procedures, as they have done so far, and also draw on international expertise.

These positions are indeed critical for the long-term future of the institute. As we have done so with recent appointments, we will continue to ensure that further hires are deeply integrated into the local university and non-university research environment. We will benefit from extensive input from our boards.

4. In recent years, more publications in peer-reviewed journals have been produced by the Großbeeren site than previously by both sites together. Its publication record must, howev-

er, continue to improve significantly. In order to realise the institute's potential, and in view of the current generational change in many leadership positions, a binding publication strategy should be determined stating which internationally reviewed journals should be the priority publication destination for new scientific results and what expectations should be fulfilled with regard to publishing in practice-related journals.

Following this advice, the Executive Board together with the Programme Area and Research Group Leaders are now drafting a clear and binding publication strategy that will be discussed with the Scientific Advisory Board and submitted to the Supervisory Board. We expect that this binding publication strategy will not only improve our publication record, but will also reflect the increased focus of the institute on research on the analysis of regulatory mechanisms.

5. IGZ has excellent scientific infrastructures (greenhouses, field experimental area and especially a phytotron with a gas-exchange greenhouse). The inherent methodological potential for the institute's own projects and, in particular, for joint undertakings with partner institutions must be exploited better. IGZ should consider whether it would be meaningful to pool the research infrastructures in an independent, and thus internally and externally more visible, core facility.

We have considered this recommendation, and indeed will establish an infrastructure core facility in spring of this year. This core facility will comprise greenhouses, growth chambers, and field experimental structures, and will be responsible to maintain, develop and utilise these facilities. In a next step, we will also pool our spectrum of genomics and metabolomics technologies as well as our plant secondary metabolite analytics to allow full accessibility of IGZ's scientific infrastructure for all research groups. This will support a further increased international visibility and collaboration of the institute.

6. Since the last evaluation, third-party income has risen by just under two percentage points but, at 12.6 percent of overall income, is still too low. In the future, the third- party portfolio should be more diversified. The proportion of DFG funding, in particular, must be increased.

Compared with the situation considered in the evaluation process (revenue from project grants 2016-2018), income from new third-party grants has sharply increased in the years 2018 and 2019. In 2019 alone, IGZ has acquired new grants of more than €3.5 M, and revenue from project grants in 2019 was equivalent to 18.5 percent of overall income. The Programme Area "Functional plant biology" has been awarded a SAW Collaborative grant in 2019 as part of the Leibniz Best Minds Programme for a three-year collaborative research project between IGZ, IPK Gatersleben and IPB Halle, strengthening research at IGZ into plant regulatory mechanisms at the genetic level. Thus, IGZ has already achieved much higher third-party income compared to the situation that was evaluated, and, based on recent developments, we are confident that the third-party portfolio will be diversified, and the proportion of DFG funding will be increased.

7. The work in the field of development economics must now be much more closely integrated into the institute's overall activities. This is still a challenge. Recently, however,

promising projects have been acquired that facilitate an alignment with horticultural value chains and eating habits. Overall, the group should intensify collaborations with partner institutions in the field.

The IGZ group of Economic Development and Food Security at present uses the newly acquired projects to intensify collaboration within the institute, and with partner institutions. Further collaboration with more national and international partner institutions will be a future focus, and will be facilitated by grants that have been recently applied for.

8. The intended increase in the number of members as well as the impending changes should allow the Scientific Advisory Board to become even more international and reflect the broad spectrum of modern horticultural research.

An important step in this direction has been completed since the visit of the evaluation group in that the language of the Scientific Advisory Board has been changed from German to English. Discussions have already been initiated in the Scientific Advisory Board to search for appropriate new members. The Scientific Advisory Board will become more international, and will cover the spectrum of disciplines represented in the IGZ such as plant biology, genetics, microbiology, environmental sciences, food science, and social sciences, all contributing to modern horticultural sciences.

9. It is very good that fundamental research has now been more firmly anchored in IGZ's statutes as the purpose of the institute. The specialist expertise on the Supervisory Board should be aligned accordingly.

The Supervisory Board of the IGZ is composed as described in the statutes of the institute. The statutes foresee a broad representation of different expertise and views in the Supervisory Board. Recently, with the new statutes of the institute the Federal Ministry of Education and Research has become an additional member of the Supervisory Board of the IGZ, thereby strengthening aspects of fundamental research in the Supervisory Board. Scientific advice for the Supervisory Board is provided by the Science Advisory Board of the institute.

We appreciate the support and advice of the evaluators as we continue to develop the IGZ as an internationally recognised institute reflecting the broad spectrum of modern horticultural research. In our view, such a research programme is of fundamental scientific interest as well as being socially relevant, and is thus well placed within the Leibniz Association.