Leibniz-Gemeinschaft

Der Senat

17. März 2016

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

Inhaltsverzeichnis

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 9. und 10. Juni 2015 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 17. März 2016 auf dieser Grundlage die vorliegende Stellungnahme. Der Senat dankt den Mitgliedern der Bewertungsgruppe und des Senatsausschusses Evaluierung für ihre Arbeit.

1. Beurteilung und Empfehlungen

Seinem **Auftrag** entsprechend betreibt das Leibniz-Institut für Gemüse- und Zierpflanzenbau (IGZ) mit den beiden Standorten Großbeeren (Brandenburg) und Erfurt (Thüringen) anwendungsorientierte Grundlagenforschung zur Qualität, Gesundheit, Ernährung und Vermehrung von Pflanzen. Ziel ist es, die wissenschaftlichen Voraussetzungen für einen effizienten und nachhaltigen Gartenbau zu schaffen. Damit greift das Institut relevante und zukunftsträchtige Themen auf, zu deren interdisziplinärer Bearbeitung es Expertise aus den Agrar- und Biowissenschaften, der Geoökologie sowie der Lebensmittelchemie bündelt.

Die Arbeiten des IGZ haben große Bedeutung für die **landwirtschaftlich-gärtnerische Praxis**. Bei der Vermittlung seiner Erkenntnisse an interessierte Bevölkerungs-, Fach- und Wirtschaftskreise ist das Institut ebenfalls erfolgreich. Um in der Forschung eine größere internationale Sichtbarkeit zu erreichen, muss es allerdings die wissenschaftlichen Grundlagen seiner anwendungsorientierten Aktivitäten weiter verbessern.

In quantitativer Hinsicht ist die **Publikationsleistung** des IGZ insgesamt angemessen. Es wird begrüßt, dass das Institut seinem Auftrag entsprechend praxisrelevante Erkenntnisse in anwendungsnahen Zeitschriften veröffentlicht. Zukünftig muss die Publikationstätigkeit in referierten wissenschaftlichen Zeitschriften aber deutlich verstärkt

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

werden. Es wird empfohlen, zur systematischen Umsetzung dieses Ziels eine Publikationsstrategie zu entwickeln.

Das IGZ ist organisatorisch in fünf Abteilungen gegliedert, vier sind in Großbeeren und eine ist in Erfurt lokalisiert. Im Sinne einer Matrixstruktur werden die inhaltlichen Arbeiten vier Bereichen (*research domains)* mit 13 Untereinheiten (*research areas*) zugeordnet. Der Bereich 1 *Gartenbaupraxis* hat „sehr gute" **Leistungen** im Wissenstransfer gartenbaulicher Erkenntnisse in Anwendungskontexte vorzuweisen. Die beiden Forschungsbereiche 3 *Gartenbau, Umwelt und Verbraucher* sowie 4 *Globale Änderungen und Gartenbau* werden als „sehr gut bis exzellent" bzw. als „sehr gut" bewertet. Die Leistungen im größten Forschungsbereich 2 *Nutzung biologischer Regelungssysteme im Gartenbau* sind heterogen, insgesamt aber „gut". Drei durch Abteilungen in Großbeeren getragene Untereinheiten weisen sehr überzeugende Leistungen auf und haben das Potenzial, das Institut voranzubringen. Drei weitere, maßgeblich durch die Abteilung in Erfurt getragenen *research areas* (*Adventivwurzelbildung und Entwicklung*, *Samen- und In-vitro-Vermehrung*, *Entwicklung neuer Genotypen)* werden dagegen als wissenschaftlich wenig erfolgreich bewertet. Diese Arbeitseinheiten erfüllen nicht mehr die Anforderungen und werden vom Senat als „nicht hinreichend" beurteilt.

Nach der Wiedervereinigung wurde das IGZ als Institut mit **zwei Standorten** gegründet. Rund drei Viertel des Personals entfallen auf Großbeeren, rund ein Viertel auf Erfurt. Der Senat stellt fest, dass die wissenschaftliche und infrastrukturelle Entwicklung der beiden Standorte deutliche Unterschiede aufweist:

Am **Standort Erfurt** stagniert die Entwicklung: Ein neues Gewächshaus befindet sich seit Jahren lediglich im Stadium der Planung und auch die Zusammenarbeit mit der Universität Jena wurde nicht in erkennbarer Weise intensiviert, wie es bei der letzten Evaluierung empfohlen worden war. Vor allem aber sind in Erfurt die vom Senat als „nicht hinreichend" beurteilten Untereinheiten *(research areas)* lokalisiert.

Der **Standort Großbeeren** hat sich dagegen in den letzten Jahren sehr positiv entwickelt. Der Forschungsbereich wurde dort personell sowie infrastrukturell in überzeugender Weise gestärkt und die Kooperationen mit Hochschulen in Berlin und Brandenburg sehr erfolgreich ausgebaut. Dementsprechend kann das Institut hier mittlerweile auch in der grundlagenorientierten Forschung auf beachtliche Erfolge verweisen. Empfehlungsgemäß wurde eine weitere gemeinsame Berufung mit der Humboldt Universität zu Berlin durchgeführt. Hinzu kamen zwei gemeinsame Berufungen mit der Universität Potsdam; eine weitere ist dort mit der Nachbesetzung der seit Anfang 2015 vakanten Abteilungsleitung *Pflanzenernährung* vorgesehen. Sie hat auch aus Sicht des IGZ oberste Priorität und muss nun zügig vorangetrieben werden. Der Senat begrüßt die weiteren Planungen zur Stärkung der Kooperationsbeziehungen in der Region. Allerdings sollte die Einrichtung der vom IGZ geplanten gemeinsamen Professur *Biodiversität und Nachhaltigkeit* mit der Freien Universität Berlin zunächst zurückgestellt werden. Zwar handelt es sich dabei um eine auf lange Sicht strategisch sinnvolle Ergänzung, bevor sie realisiert werden kann, muss sich das IGZ aber auf die Umsetzung der Evaluierungsempfehlungen konzentrieren. Darüber hinausgehende Überlegungen für andere Erweiterungen sollten, wie im Bewertungsbericht erläutert, nicht weiterverfolgt werden. Es hat sich

bewährt, dass durch eine Änderung der Ressortzuständigkeit in Brandenburg seit 2012 empfehlungsgemäß das Wissenschaftsministerium zuständig ist.

In Großbeeren verfügt das IGZ mittlerweile auch über eine **Infrastrukturausstattung**, die auch im internationalen Vergleich sehr hohen Standards genügt. Besonders hervorzuheben ist das im Jahr 2014 in Betrieb genommene Großphytotron mit integrierten Gaswechsel-Gewächshäusern, für das auch umfangreiche EU-Mittel eingesetzt wurden. Der Senat erwartet nun, dass diese Investitionen künftig auch gezielt zur Einwerbung von Drittmittelprojekten mit ausgewiesenen internationalen Kooperationspartnern genutzt werden, denn bereits bei der letzten Evaluierung war die **Drittmittelsituation** am IGZ kritisiert worden. Seit 2014 ist ein Aufwärtstrend festzustellen, der sich in den nächsten Jahren weiter fortsetzen muss.

Der **wissenschaftliche Nachwuchs** wird am IGZ sehr gut ausgebildet und betreut. Seit der letzten Evaluierung wurden in Großbeeren zwei Nachwuchsgruppen und eine Juniorprofessur eingerichtet. Damit ist das Institut auf einem guten Weg, um wie empfohlen die Anzahl hochqualifizierter promovierter Nachwuchskräfte weiter zu steigern.

Im wissenschaftlichen Bereich besteht am IGZ ein ausgeglichenes Zahlenverhältnis von Männern und Frauen. Auch auf Leitungsebene ist das Institut diesbezüglich bereits sehr weit, so dass die **Geschlechterparität** beinahe erreicht ist.

Der Wissenschaftliche Beirat begleitet das Institut konstruktiv und kritisch. Insgesamt muss die **Qualitätssicherung** jedoch noch stärker auf eine Verbesserung der internationalen wissenschaftlichen Sichtbarkeit des Instituts ausgerichtet werden.

Mit der Bearbeitung langfristig angelegter Fragestellungen des Gemüse- und Zierpflanzenbaus auf der Grundlage einer umfangreichen und hochwertigen Infrastruktur erfüllt das IGZ Aufgaben, die in dieser Form nicht an einer Hochschule wahrgenommen werden können. Die Eingliederung in eine Hochschule wird daher nicht empfohlen. Mit seinen Transferleistungen ist das Institut für die landwirtschaftlich-gärtnerische Praxis von großer Bedeutung. Um jedoch auch auf längere Sicht den Ansprüchen an eine Forschungseinrichtung von überregionaler Bedeutung und gesamtstaatlichem wissenschaftspolitischem Interesse zu genügen, muss das IGZ sein wissenschaftliches Profil schärfen und seine Leistungen weiter steigern. Der Senat empfiehlt, das IGZ auf den Standort Großbeeren zu konzentrieren und die Arbeiten in Erfurt zu beenden. Er erwartet, dass diese Fokussierung die wissenschaftliche und administrative Steuerung des Instituts deutlich erleichtert und so zu einer Steigerung der Leistungen in Relation zu den für das Institut eingesetzten Mitteln führen wird. In vier Jahren soll überprüft werden, wie sich das Institut unter den geänderten Rahmenbedingungen weiterentwickelt hat.

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 am Standort Großbeeren weiter zu fördern und die Förderung am Standort Erfurt zu beenden.

Außerdem empfiehlt der Senat, die nächste Überprüfung der Fördervoraussetzungen des IGZ in vier Jahren (2020) vorzusehen.

1 June 2015

Annex A: Status Report

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

Contents

1. Structure, Tasks and Institutional Environment

Development and funding

The Leibniz Institute of Vegetable and Ornamental Crops (IGZ) is located at two sites, Großbeeren (Brandenburg, close to Berlin) and Erfurt (Thuringia). In Großbeeren, a research institute for horticulture was established in 1924, extending the agricultural research stations of the Friedrich-Wilhelm-Universität in Berlin (now: Humboldt Universität zu Berlin). Erfurt has been a historical centre of ornamental plant breeding and production already in the early 20th century. In the German Democratic Republic, the VEG *Saatzucht-Zierpflanzen Erfurt* was a leading institution for applied research on ornamental plants.

After German reunification, the German Council of Science and Humanities (*Wissenschaftsrat*) suggested establishing a new horticultural research institute with sites in Großbeeren and Erfurt. The IGZ was finally set up in 1992. Since then it has been jointly funded as member of the *Arbeitsgemeinschaft Blaue Liste* and, as an institute of Leibniz Association subsequently. Its national importance was confirmed in external evaluations by the German Council of Science and Humanities in 2000 and by the Senate of the Leibniz Association in 2008.

RESPONSIBLE DEPARTMENTS AT LÄNDER LEVEL: Ministry of Science, Research and Culture of the State of Brandenburg (MWFK) and Thuringian Ministry of Infrastructure and Agriculture (TMIL)

RESPONSIBLE DEPARTMENT AT FEDERAL LEVEL: Federal Ministry of Food and Agriculture (BMEL)

Mission and tasks

The IGZ conducts fundamental research in the fields of vegetable and ornamental crops thereby striving to be an active link between progress in the natural sciences and the reality of horticulture, environment, and society.

IGZ aims at contributing to the success of horticulture, to the understanding of fundamentals of horticultural, environmental and plant science, to sustainability in production and use of plants, and to a healthy nutrition and well-being of consumers. To this end, IGZ cooperates closely with national and international universities, universities of applied sciences, non-university research institutions, extension centres, and other organisations.

Legal form and organisation

IGZ has the legal status of a registered association (*eingetragener Verein*). It is a non-commercial, non-profit entity.

The GENERAL ASSEMBLY as the supervisory body of IGZ is responsible for all fundamental issues concerning the registered association. It is chaired by the representative of the

Ministry of Science, Research and Culture of Brandenburg and convenes at least annually.

The SCIENCE ADVISORY BOARD (SAB) consists of scientists from horticulture and plant science and has a maximum of eight members who are appointed for four year terms by the General Assembly and may be reappointed once. The SAB advises the institute on all research activities. It supports the General Assembly in recruiting senior staff. The SAB convenes at least annually. It evaluates IGZ regularly and reports the results to the General Assembly.

The EXECUTIVE BOARD consists of three scientists and the head of the administration unit. The scientific director chairs the Executive Board. He is appointed by the General Assembly for a maximum of five years, and may be reappointed. The Executive Board meets at least monthly, and reports its discussions and decisions to a group of staff representatives (the so-called "service and research consultation").

The RESEARCH STAFF ASSEMBLY comprises all IGZ scientists. It drafts the research programme and elects one of the members of the Executive Board. It also bears the task of safeguarding good scientific practice.

Research structure

IGZ staff is organised in five disciplinary departments (Plant Nutrition, Plant Health, Plant Propagation, Plant Quality, Modelling and Knowledge Transfer) and the administration unit. The departments are responsible for career development of the personnel and for maintenance of the scientific infrastructure. Research takes place in four interdisciplinary Research Domains (RD) each consisting of several Research Areas (RA; see the organisational chart of IGZ in Appendix 1). Work in the Research Areas is organised in projects. Material resources are distributed among Research Areas.

IGZ has experimental operation groups, comprising gardeners and greenhouse technicians, at both sites (Großbeeren and Erfurt). As central units, these groups report directly to the IGZ Executive Board.

National and international scientific environment

IGZ is a horticultural research centre with a broad scope. Its research profile embraces interdisciplinary horticultural issues combined with aspects of environmental and life sciences. The profile of IGZ is distinct from the profile of specialised institutions of basic research, but also from the profile of applied research centres.

On the national level, there are partner institutions with complementary research foci, e.g. in human nutrition (German Institute of Human Nutrition DIfE, Max Rubner-Institut MRI), in plant-microbe interaction (Leibniz Institute of Plant Biochemistry IPB, Leibniz Centre for Agricultural Landscape Research ZALF, Leibniz Institute of Plant Genetics and Crop Plant Research IPK, Helmholtz Centre for Environmental Research UFZ, Center for Biotechnology CeBiTec) and in plant-environment interaction (Julius Kühn-Institut JKI, Max Planck Institute of Molecular Plant Physiology MPIMP, Helmholtz Zentrum

München, German Research Center for Environmental Health). The Forschungszentrum Jülich investigates mainly agricultural crops, model plant and tree species.

The federal research institutes under the umbrella of the BMEL, such as the Max Rubner-Institut (MRI), the Thünen-Institut (TI) and the Julius Kühn-Institut (JKI) are working on topics that interface with horticulture – such as consumer health protection and sustainable production of agricultural crops. The Chambers of Agriculture (*Landwirtschaftskammern*) and, for example, the State Advisory Centre of Rhineland-Palatinate (DLR) focus on solving urgent problems of specifically local or regional importance whereas IGZ pursues a research agenda with a more global, long-term perspective.

Internationally, institutions such as The National Institute for Agricultural Research INRA in France or Wageningen UR in the Netherlands, among the leading institution in Europe, also link basic and applied research in the agricultural sector, albeit at a much larger level. In comparison, IGZ as a smaller institute concentrates on research-based approaches in a few key horticultural themes. Partly comparable to the IGZ, the John Innes Centre, UK, embraces fundamental science through to strategic applications and practical outcomes, but covering a distinctly broader range by considering mainly agricultural crops and just partly horticultural relevant species. In contrast to IGZ, the Research Institute for Organic Agriculture (FiBL), Switzerland, is highly specialised in organic agriculture.

The research and development institute World Vegetable Center (AVRDC) has a declared interest in applied research to alleviate poverty and malnutrition in the developing world through increased production and consumption of nutritious and health-promoting vegetables. In addition, the CGIAR institute, Bioversity International, is a global research-for-development organisation working exclusively on applied solutions to improve agricultural biodiversity and attain global food and nutrition security. Another important reference for IGZ is the horticultural work by the Food and Agriculture Organization of the United Nations (FAO).

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

Topical horticultural challenges are investigated at IGZ within joint projects by researchers representing a broad diversity of disciplinary backgrounds. Many IGZ publications are co-authored by an interdisciplinary research team. According to the institute, this approach with long-term research cooperation and excellent research facilities is well in line with the Leibniz Association profile and complements research at universities. In addition to its scientific performance, IGZ functions as a policy advisor and partakes in dialogues with various stakeholder groups. The institute sees itself accepted as a qualified mediator between horticultural practice and science, thus underlining its supra-regional significance and the institute's relevance to national science policy.

2. General concept and profile

Development of the institution since the last evaluation

Within the past few years, IGZ profile has been modified only slightly:

- Following a recommendation of the previous evaluation, IGZ puts more emphasis on basic biological plant research using molecular biology.
- Answering an increased interest of students and young scientists in IGZ work, the institute hosts many more bachelor and master students, more visiting students and guests. Applicants come from very different areas of study and mostly do not have a specific horticultural background.
- The demand on contributions from IGZ staff for advice and support has clearly risen. IGZ concentrates on research-based recommendations.

In the past few years, three new Research Areas have been included into the IGZ portfolio (for details see chapter 3):

- "Function and importance of carotenoids and apocarotenoids" (since 2012; joint junior professorship with University of Potsdam for Analytical Food Chemistry of Secondary Plant Metabolites)
- "Molecular basis of plant performance" (since 2013; joint professorship with University of Potsdam on Plant Metabolism)
- "Green city – Urban horticulture" (since 2014; Advertisement for a joint professorship on Ecological Vegetable Production with the *Hochschule für nachhaltige Entwicklung Eberswalde* in April 2015)

Additionally, in 2012 IGZ has launched two junior research groups ("Detection, biosynthesis and function of flavonoids" and "Nitrogen use efficiency in field vegetable production").

Results

In the period 2012-2014, IGZ scientists contributed to more than 500 publications, 36% of them as articles in peer-reviewed journals (see Appendix 2 for details). IGZ states that since the last evaluation the number of peer-reviewed publications increased, and also the quality of the journals the articles appeared in. According to the institute, the average impact factor of IGZ publications rose from less than 1.0 in 1995 to 3.5 in 2014.

Research highlights in the period 2007-2014 include:

- IGZ revealed that secondary plant metabolites respond to specific elicitor treatment in a strong structure-dependent manner, and that also the functional effects are distinctly dependent on the chemical structure of the secondary plant metabolites.
- IGZ contributed to a deeper understanding of the formation and function of carotenoid derived aroma compounds (apocarotenoids), including a pilot study using quantum dot nanoparticles for in vivo visualisation.
- By integrating molecular marker analyses and results from classical breeding experiments, IGZ elucidated the inheritance of the economically very important "bud blooming" trait of heather on polyploid level. From these data, IGZ deduced a strategy for breeding triploid bud blooming genotypes.

- IGZ identified the proteasome as a non-classical virulence target of phytopathogenic bacteria to interfere with hormonal defence pathways.
- IGZ showed that polar auxin transport is essential for a 24-h peak of indole-3-acetic acid, induction of adventitious roots and activation of invertases in the rooting zone and that switches in the expression of *Aux/IAA* genes may guide the entrance into different phases of adventitious root formation.

IGZ scientists are also committed to scientific consultancy. They serve as reviewers, editorial board members and editors on editorial boards of scientific journals (e.g. Scientia Horticulturae) and are members of professional boards and committees (e.g. of Advisory Groups to the Research Directorate of the European Commission and as former vice president of the European Plant Science Organisation EPSO). IGZ highlights the following scientific consultancy issues:

- IGZ coordinated the development of the "Future Strategy in German Horticulture 2020" bringing together 260 experts from the horticultural sector, and interfaced societal and science fields. Based on more than ten strategic workshops, conclusions and recommendations were outlined in the Final Report "*Zukunftsstrategie Gartenbau* – Future Strategy in Horticulture".
- In 2014, IGZ was asked by the Federal Ministry of Food and Agriculture (BMEL) to join the advisory group on the amendment of the Fertilisation Directive (*Novelle der Düngeverordnung* 2015). The text of the amended law includes target values for vegetable fertilisation, as suggested by IGZ. The amended Fertilisation Directive will come into effect in 2015, after the required clearance from the EU.

According to the institute, IGZ scientists keep close contact with the horticultural industry and are frequently invited to present their results at meetings of growers, breeders and their associations. Other knowledge transfer strategies of IGZ:

- The institute publishes and provides results of applied IGZ research projects as open access documents on the IGZ server. Currently, 21 documents are available. The compendium "*Düngung im Freilandgemüsebau*" (Fertilization of Field Vegetables), for instance, was downloaded approximately 35 000 times in 2014.
- IGZ offers expert system software for vegetable growers and advisers, among them the fertiliser recommendation system N-Expert, as a free download.
- Several agro-ecosystem models that were developed by IGZ are used in Decision Support Systems for vegetable growers. One of them is "Greenman", used for greenhouse crops and prepared in collaboration with a team of the Volcani Center, Israel.
- IGZ participates in joint model, demonstration and knowledge-transfer projects involving growers, state and private advisory organisations and horticultural research institutes. The projects aim to provide on-farm demonstration, analysis and dissemination of measures of good agricultural practices.
- In the joint research project "ZINEG – The Low Energy Greenhouse", 11 partners developed greenhouse technologies that significantly reduce energy consumption and, thereby, CO_2 emissions in greenhouse plant production. The National German Sustainability Award (*Deutscher Nachhaltigkeitspreis*) was granted the project consortium in 2014. Dissemination to the horticultural industry is provided, for instance, by the Internet platform www.zineg.net.

Between 2012 and 2014, IGZ held three patents and three other industrial property rights. In 2012, the spin-off Geophilus Soil Mapping Service GmbH was founded by IGZ staff. The company uses electrical remote sensors to generate high-resolution 3D soil maps, which are required for precision farming. The technical know-how and the remote sensors were developed in close cooperation with University of Potsdam.

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, e.g. the 5th International Symposium on *Rhizoctonia* (Zhengzhou, China, 2013). During the last few years, many workshops were held at the two sites of IGZ, Großbeeren and Erfurt. Larger conferences were arranged at other locations in and around Berlin and Erfurt, e.g. the 12th World *Petunia* Days (Erfurt, 2012) and the 7th International symposium on root development (Weimar, 2014).

IGZ organises events for the public at the institute, e.g. the annual "IGZ-day of open doors" in Großbeeren. IGZ staff often participates in public events such as the yearly "*Lange Nacht der Wissenschaften*" (Long Night of Science) in Erfurt, and the biannual worldwide event "Fascination of Plants Day". Press releases are published on specific occasions, e.g. on the opening of the new phytotron in 2014. The institute's website was re-launched in 2014. IGZ often receives requests for guided tours around the sites from schools, horticultural societies or from embassies, with approximately 50 guided tours realised per year.

Strategic work planning for the next few years

In the view of IGZ, in the future, horticultural research should be fully integrated with other biological and environmental sciences and also consider societal and economic aspects of plant utilisation. The IGZ plans to place more emphasis on research that investigates the role of biodiversity in horticultural plant use systems. In addition, the institute sees the need to improve its understanding of the sustainability of traditional and new concepts for horticultural plant utilisation. To this end, IGZ wants to strengthen the existing partnerships with universities and other research institutions such as the Berlin universities, the University of Potsdam, and the Max Planck Institute of Molecular Plant Physiology in Golm.

The following joint assignments are in progress. They are part of the work programme for the next few years:

- Ecological Vegetable Production (joint professorship with *Hochschule für nachhaltige Entwicklung* Eberswalde; position advertised)
- Developmental Genetics of Plants (joint professorship with Friedrich-Schiller-Universität Jena; text of position advertisement presently under discussion with the university)

IGZ plans to implement several new positions and facilities within the next two years. Due to some flexibility in personnel expenses many of the new positions can be financed out of the current budget. IGZ plans the following measures:

1) The position of the head of the IGZ's "Plant Nutrition" department has been vacant since January 2015. This occasion will be used to establish a joint research group on "Plant Nutritional Genomics" at IGZ, the Max Planck Institute of Molecular Plant Physiology (MPIMP) and the University of Potsdam (UP). The position of department head may be combined with a new joint professorship with University of Potsdam. This position is expected to be filled early in 2016.
2) In order to increase the international visibility of IGZ and to provide a long-term framework for students and guest scientists, in 2015 a Joint Research Lab on the "Management of Fungal Biodiversity in the Rhizosphere" is planned, involving cooperation between the FU Berlin (Institute for Biology and Ecology of Plants) and IGZ.
3) IGZ also plans to establish in 2015 a Joint Research Lab on "Horticultural Plant Breeding Research" with the Fachhochschule Erfurt (FHE), Faculty of Landscape Architecture – Horticulture and Forestry.
4) IGZ plans to set up a Leibniz Campus "Exploiting Opportunities from Horticultural Genomics" with University of Potsdam. A proposal for funding in the Leibniz competition scheme "Strategic Networks" (*Förderlinie Strategische Vernetzung*) is expected to be drafted in summer 2015.

Additionally, IGZ plans new joint appointments that may be realised only through a "Minor extraordinary item of expenditure of scientific-strategic nature" (*Kleiner Sondertatbestand*) for two new joint appointments with complementary staff (two scientists per joint appointment). For these six new positions a budget increase for IGZ of approximately 500 k€ per year is required:

5) A new joint professorship on "Biodiversity and Sustainability" is planned with the Freie Universität Berlin (FU Berlin, Department of Biology, Chemistry and Pharmacy). The primary focal areas of this joint professorship will be:
   - Plant-microbe interactions: resource allocation between plants and the rhizosphere microbiome
   - Physiological trait combinations: diversity of functions, diversity of resource use
   - Soil-plant-land area functionality relationship: coupled dynamics of plant and ecosystem water, carbon and nutrient fluxes

   With this new joint professorship, IGZ will intensify cooperation with the research groups of the FU Berlin and the Dahlem Centre of Plant Sciences (DCPS).
6) IGZ plans to establish a development economics department, together with a new joint professorship on "Development Economics in Horticulture". The aim is to establish in-house capacity for research on the economic development aspects of vegetable and ornamental plant production, leading to joint research and advisory projects across a multiplicity of themes and disciplines.

Appropriateness of facilities, equipment and staffing

Appendix 3 gives a detailed list of IGZ's revenue and expenditure from 2012 to 2014. In 2014, IGZ's revenue totalled approximately 15.3 M€. The institutional funding by Federal and *Länder* governments according to AV-WGL amounted to 10.2 M€.

In the period from 2012 to 2014, the revenue from project funding grants accounted for between 14% (2012) and 8% (2014) of the institute's revenue. IGZ explains this relatively low share with the fact that it receives many grants from a broad range of funding agencies (Federal Ministries, industry, EU, DFG), but that most grants are relatively small (for example, in 2012 the IGZ received 13 grants with an average amount of 32.3 k€). In the opinion of the institute, this is partly due to the common belief that horticultural research can be done with relatively small resources. Moreover, the institute states that many hort3icultural breeders and producers represent small- or medium-size companies, resulting mostly in low-budget joint projects. In addition, according to the institute, it was involved in several EU COST Actions, which are typified by a high networking character, but also by low grants. However, according to the institute, more emphasis has been placed on grant procurement in the past years. The institute states that in 2014, more than 2 M€ in new grants have been obtained (a total of 24 grants with an average amount of 87.0 k€). New funds obtained in 2015 include an EU grant of approximately 0.5 M€. The IGZ aims to further increase the share of DFG- and EU-funding.

After the evaluation in 2007, an increase in the staff appointment scheme (*Stellenplan*) by almost 10% was made possible. Since then, the institute has increased its core staff moderately and consolidated its structure (for details see chapter 5). For future planning on increases in staff via an "Extraordinary item of expenditure" (*Sondertatbestand*) see sub-chapter "Strategic work planning" above.

Following the recommendation of the last evaluation, IGZ supported its Information Technology (IT) with a new position. Along with renewing the complete physical network, the institute established a solid, uniform basis for IT. Since 2014, both the institute's locations in Großbeeren and Erfurt are connected to the network infrastructure of the German Research Network (*Deutsches Forschungsnetz*, DFN).

In the last few years, IGZ's spatial and experimental basis was renewed:

- IGZ operates greenhouses, field experimental areas, plant growth chambers and open field box plots, including laboratory space and research equipment at the Großbeeren and Erfurt sites of the institute. In Großbeeren, several long-term field experiments investigate in particular the function of organic matter management in fertility of soils in horticultural crop rotations. An additional station at Golzow/Oder-bruch supports field experiments when more than one location is required.
- At the Großbeeren site, EFRE funds amounting to 1.2 M€ were raised for research facilities and 11.7 M€ for building measures (5.7 M€ for reconstruction of the laboratory building and 6 M€ for the new phytotron/gas exchange greenhouse). From a federal investment funding programme (*Konjunkturprogramm II*) a total of 205 k€ were raised for the construction of a photovoltaic facility and 423 k€ for an energy-efficient refitting of the institute building.

- At the Erfurt site, a total of 532 k€ were invested to rebuild newly obtained rooms into a total 126 m^2 laboratory space and to modernise 34 m^2 of existing laboratory space. Construction of new greenhouse facilities in Erfurt is required to permit future experiments under conditions similar to current horticultural practice. Therefore, in 2011, 70 k€ were provided for planning. The corresponding funds for the construction work have been requested for 2016, amounting to approx. 4.8 M€. At present, according to the IGZ, realisation depends on a final decision for financial support by the state of Thuringia.

3. Subdivisions of IGZ

Research Domain 1 – "Horticultural practice and urban horticulture" (6 FTE) embraces the traditional focus of IGZ work (RA1.1) and a new direction of interest (RA1.2):

The task of RA1.1 "Horticultural practice and production" is to collect results from other RAs, synthesise them into practical solutions, and transfer them into horticultural production, processing and trade (also see chapter 2).

The group presents IGZ findings at conferences of horticultural specialists (examples: reduction of fertilisation, seedling production, asparagus harvest strategies), uses IGZ models in internet-based advice systems (for example, on plastic-covered early vegetation cultivation in the field) and evidence from IGZ in legislation processes.

The planning is dependent on the findings of the other IGZ RAs. It will include, for example, the adaption of the N-Expert recommendation system and the N-Expert software to the expected amendments of the German Fertilisation Directive and the extension of the asparagus bed temperature forecast tool across Germany, together with Information System Integrated Plant Production (www.isip.de).

RA1.2 "Green city – Urban horticulture" aims at contributing to safe gardening, fertile substrates and nutrient recycling in urban environments, in cities such as Berlin, but also in other regions of the world. IGZ started discussing new forms of urban horticulture in 2013. The RA was established in 2014 and, according to IGZ, still mainly is a student based research group.

The group built up a network of practicing urban gardeners, construction engineers for innovative composting and sanitation systems, and plant nutritionists and physiologists. It has identified safe and fertile substrates from recycled material as one of the main research objectives for urban gardening. Therefore, at present, the group is testing composting effects of, for example, sanitised faeces or Terra Preta-type substances.

In the near future, research in RA1.2 will focus, amongst others, on the enhancement of the nitrogen fraction in compost substrates by targeted selection of N-rich organic waste material and on the prevention of nitrogen losses from compost substrates. In transdisciplinary cooperation, the group will advance the practical application of sanitation and composting principles, both in community gardens and in small urban enterprises. Work in Africa will be continued. It is intended to consider social and

economic aspects of development together with the new professorship on "Development Economics in Horticulture" (see sub-chapter "Strategic work planning" above).

Research Domain 2 – "The use of biological systems in horticulture" (46 FTE) covers regulatory principles involved in genetic determination of flower development, regeneration of roots and of whole plants, acclimation and adaptation of plants and microbes to abiotic stress factors, plant-pathogen interactions and plant-fungus mutualism. The aim is to elucidate underlying biological regulatory principles in horticultural systems, and to identify new starting-points for precise knowledge-based control of horticultural plants and products. Following the recommendation of the last evaluation, molecular genetic approaches have been strengthened. RD2 is structured into six Research Areas:

In RA2.1 "Control of adventitious root formation and further development of ornamental crops", the core horticultural model system *Petunia* has been developed, including the addition of plant hormone analysis, a microarray and a complete genome sequencing, which is still under progress in cooperation with international partners. A project grant allowed for the expansion of the research programme into chilling tolerance.

The group elucidated the contribution of polar auxin transport to the induction of early cellular events and sink establishment in the rooting zone. Analysis of transcriptome data helped to fine-tune the concepts on the regulatory roles of auxin and ethylene. Results on the role of air versus root zone temperature induced changes in commercial settings to reduce energy consumption. A first protocol of non-invasive quality assessment of cuttings was developed.

The access to the complete genome of *Petunia* provides perspectives particularly for studying the functional role of identified candidate genes and to assign the controlled processes to individual tissues, cells or compartments. The group also wants to implement protocols for transformation and for virus-induced-gene-silencing and to continue its concept of knowledge transfer via cooperation with producers.

RA2.2 "Biological and technological fundamentals of seed and *in vitro* propagation" carries out research on seed quality of ornamental plants and *in vitro* propagation via somatic embryogenesis. In addition, this RA includes vegetable seed quality research and the potential of apomixis for developing an alternative propagation method in the research programme.

The group addresses research in embryogenesis-based propagation systems. Results indicate that somatic embryo-like structures in *Fragaria* cannot be classified as somatic embryos. It was possible to show the strong influence of phosphorus supply and inoculation with *Piriformospora indica* on the seed-carrying mother plants for supporting seed formation in *Cyclamen*.

In discussions with the German breeders and seed producers association, major research fields were defined: the determination of seed characteristics that contribute to seed quality and of pre-harvest factors that influence seed quality; investigation into new phyto-sanitary applications, such as non-thermal plasma.

RA2.3 “Biological principles for the optimisation of integrated pest management” mainly studies soil-borne diseases on vegetables and downy mildew-diseases on herbs. The goal of RA2.3 is to provide baseline data needed for the development of effective and sustainable control methods.

The group found that the effects of inoculant strains to suppress bottom rot disease severity on lettuce caused by the soil-borne pathogen *Rhizoctonia solani* were not impacted by the soil type but by the application mode. It could show that non-ribosomally synthetized secondary metabolites of an inoculant strain (*Bacillus amyloliquefaciens* FZB42) are actually produced in the lettuce rhizosphere and contribute to the disease suppression by mediating plant defence gene expression towards *R. solani*.

Work planning in RA2.3 will focus on the molecular basis of plant pathogen interaction and the analysis of how agricultural management strategies affect the ability of a soil to suppress plant pathogens. Moreover, RA2.3 will focus on broadening tools for proteome analysis to close the analytical gap between established transcriptome and metabolome technologies at IGZ.

In RA2.4 “Principles of developing new genotypes for breeding of ornamentals and vegetables” the expertise in applied genetics and breeding research was concentrated and strengthened. This has been combined with an expansion of the use of molecular methods as molecular markers and gene expression analyses. The aim of RA2.4 is the development of breeding techniques and strategies that help in the generation of new genotypes.

In five grant cooperation projects with commercial breeders, the group improved breeding programmes of different horticultural crops by analysis of flower- and fertilisation biology. Gene expression analyses in *Calluna vulgaris* elucidated the genetic basis of changes of the flower anatomy. A corresponding locus has been mapped and molecular markers were generated for selection and genotype identification. Methods for ploidy manipulation and a strategy for breeding of polyploids were developed.

The former head of the group has recently obtained a professorship at Fachhochschule Erfurt (FHE, University of Applied Sciences). It is intended, though, to continue work in a “Joint Research Lab of Horticultural Plant Breeding” in cooperation with Fachhochschule Erfurt. RA2.4 will also closely cooperate with the new joint professorship with Friedrich-Schiller-Universität Jena on Developmental Genetics of Plants (see sub-chapter “Strategic work planning” above).

RA2.5 “Function of root-fungus interactions” (established in 2013) has been developed around the joint professorship of the IGZ with Humboldt Universität zu Berlin on “Molecular phytopathology” and focusses on interactions between the plant root and root-colonising microorganisms. The group investigates how mycorrhizal and endophytic fungi support the function of root systems and affect parameters relevant for plant production systems. Based on the recommendation of the last evaluation to strengthen research on arbuscular mycorrhiza, research on major aspects of this mutualistic symbiosis were intensified.

Gene expression and functional analyses has increased the knowledge of nutrient exchange in mycorrhizal symbiosis. These investigations revealed the role of the particular proton-pumping ATPase MtHA1 for phosphate transfer from the fungus to the plant and the importance of the sucrose transporter SlSUT2 for plant control over fungal spread inside the roots.

The work planning comprises two major lines: The further testing of IGZ models on *arbuscular mycorrhiza* functioning and the analysis of two other important groups of fungal root colonisers (*Piriformospora indica* and Dark Septate Endophytes DSE). RA2.5 will also be supported by the Joint Research Lab on "Management of Fungal Biodiversity in the Rhizosphere" and will cooperate with the new joint professorship "Biodiversity and Sustainability" with the Freie Universität Berlin (see sub-chapter "Strategic work planning" above).

The new RA2.6 "Molecular basis of plant performance" was established in October 2013 around the joint professorship of the IGZ with University of Potsdam on "Plant Metabolism" and is part of the strategic commitment of IGZ to strengthen fundamental and molecular plant research. The overall aim of this RA is the identification and functional characterisation of those gene and protein functions that limit plant productivity under non-stressed condition, as well as of novel molecular and metabolic components of stress signalling and acclimation.

The group seeks to identify and functionally characterise novel genes with regulatory roles in plant interactions with the environment. Using systematic protein-protein interaction studies and functional gene analyses, it has identified novel components of plant energy signalling and pathogen defence, respectively. The group for the first time showed that the plant proteasome acts as a virulence target for bacterial pathogens.

Work planning for the next few years focuses on the functional analysis of metabolite signalling in plants and of bacterial T3E proteins. RA2.6 will interact closely with the new joint research group on plant genomics of IGZ, the Max Planck Institute of Molecular Plant Physiology (MPIMP) and the University of Potsdam (UP; see sub-chapter "Strategic work planning" above).

In **Research Domain 3 – "Horticulture, environment and the consumer" (24 FTE)** IGZ studies secondary plant metabolites with relation to plant quality and human health as well as pathways of nutrient dynamics in horticultural agro-ecosystems, with the aim to develop new crop production strategies that are both environmentally and economically sustainable. The Research Domain is organised in three Research Areas, with two junior research groups as sub-groups to RA3.1 and RA3.3 (both since 2012):

RA3.1 "Bioactive secondary plant metabolites in the interaction plant-environment", focusing especially on glucosinolates and flavonoids (junior research group), was extended by a research topic dedicated to the investigation of saponins.

The group in RA3.1 was the first to determine that glucosinolates and flavonoid glycosides respond to specific elicitor treatment in a strong structure-dependent way and that also their functional effects are distinctly dependent on their chemical

structure. Also, the group primarily identified *BrCYP81F4* in pak choi as one gene encoding the side chain modification of indole glucosinolates.

Work planning for the next few years includes further research on the functional effects of distinct secondary plant metabolites in humans. Also, to complement work with vegetables grown in temperate regions and to capture more of the plant's diversity, the group will investigate the composition of secondary plant metabolites in indigenous Asian and African vegetables. It is intended to consider the possible welfare aspects effects of such research together with the new professorship on "Development Economics in Horticulture" (see sub-chapter "Strategic work planning" above).

RA3.2 "Function and importance of carotenoids and apocarotenoids" was newly established in 2012 around a junior professorship at University of Potsdam and uses a modern analytical platform to study basic and applied aspects of carotenoid metabolism in plants. Building on the expertise on carotenoid biosynthesis and catabolism, the group's most important objectives are to study the effects of environmental stimuli (e.g. light and insects) on carotenoid homeostasis, identify endogenous regulatory mechanisms of the carotenoid homeostasis, and elucidate the dietary effects of modulated carotenoid profiles.

The group demonstrated that ecophysiological conditions impact carotenoid biosynthesis as well as their degradation. It identified genes encoding enzymes involved in the formation of key flavour compounds and elucidated their importance, for example, in flowers and algae.

In the near future, the group aims to identify regulatory elements within the promotor regions of genes encoding key enzymes of carotenoid biosynthesis and degradation pathways. Another important approach is to establish a multi-analysis platform based on GC and LC-MS for the evaluation of plant materials (e.g. screening of: varieties, samples treated with different ecophysiological conditions and samples subjected to different manufacturing processes), authenticity control and identification of biomarkers. Moreover, research on the bioactive compounds will be strengthened.

The key objective of RA3.3 "Nutrient dynamics in horticultural crops" is to develop strategies for reducing nutrient losses in intensive horticultural production systems. The group uses both experimental research and scenario calculations with agro-ecosystem models. RA3.3 is divided into two subject areas: "Reduced nitrogen and phosphorus losses in intensive vegetable cropping" aims at understanding the processes of nitrogen and phosphorus dynamics in agro-ecosystems and "Nutrient demand and fertilisation strategies" comprises the applied research on fertiliser recommendation systems for farmers.

Results in RA3.3 showed that the decomposition rate of organic matter can be increased by repeated application to the same soil. Also, the group demonstrated that vegetable residues can produce high N_2O emissions on sandy soil. The "N-Expert" system helps growers to calculate fertiliser recommendations that are environmentally sound and economically feasible. Targets for fertiliser demand, as suggested by the group, will become obligatory law under the amended German Fertilisation Directive.

The future research focus will be on investigating one of the least well-understood aspects of N_2O emissions, namely the temporal and spatial distribution of their sources within so-called soil microsites (junior research group). Regarding the fertiliser recommendation system N-Expert, future research will include organic farming systems, in particular focusing on models for predicting turnover and nitrogen release of organic fertilisers. The efficient use of organic fertilisers will be one of the central issues for the new joint professorship on Ecological Vegetable Production with the *Hochschule für nachhaltige Entwicklung Eberswalde*. Work on the dynamics of plant and ecosystem nutrient fluxes will in future be supported by the new joint professorship "Biodiversity and Sustainability" with the Freie Universität Berlin (see sub-chapter "Strategic work planning" above).

Research Domain 4 – "Global changes and horticulture" (20 FTE) aims to develop environment-friendly and resource use efficient cultivation systems. This is based on multi-objective optimisation of yield, product quality and environmental considerations. More specifically, RD4 searches and develops microclimate control strategies, microbiome benefits and sustainable soil management approaches.

Regarding greenhouse production systems, RA4.1 "Control of micro climate for an efficient plant production" developed new model based algorithms to control greenhouse climate as well as nutrient and water supply. Vegetable grafting became a major theme and was established in the greenhouse control strategies as a new production technique.

The group developed strategies for greenhouse plant production that significantly reduce CO_2 emission while ensuring high yield and product quality. It revealed that grafting of vegetables may mitigate plant stresses induced by salinity, nutrient deficiencies and sub-optimal temperature. The group developed simulation models for plastic cover management in horticulture.

Future research will focus on the utilisation of renewable energy. Research on the reduction of CO_2 emissions will be accompanied by the development of technologies for closed irrigation loops. The group intends to measure the evapotranspiration of asparagus fields, and, concerning the activities in the field of plastic cover management will focus on the extension of both spatial coverage and the usability of model forecasts.

RA4.2 "Efficiency and stability of production systems" works on different spatial and temporal scales. The spatially smallest and temporally fastest scale within RA4.2 is the communication and interaction between the plant and its microbiome. On a field level, the group focuses on the variability of physical soil properties, and on bacterially mediated nutrient acquisition processes in the rhizosphere. On the largest scale of this RA, productivity and efficiency of European agro-ecosystems were investigated using results of long-term field experiments performed in different environments.

Main results: A plant growth promoting (PGP) bacterial strain expresses plant species- and genotype-specific PGP communication. This strain was biotechnologically formulated as a bio preparation and transferred to the farm production level. A multi-

sensor geophysical measurement system was developed to generate highly resolved soil data for precision farming purposes. The mapping service was outsourced.

Work planning for the next few years includes research on the plant microbiome diversity impact on plant nutrition and vitality, and the microbial impact on the quality of vegetables, herbs and sprouts. Additionally, proximal soil sensing will be part of IGZ activities.

4. Collaboration and networking

Collaboration with universities

IGZ has formal collaboration contracts with eleven universities. Particularly close relationships exist with Humboldt Universität zu Berlin (HU) and University of Potsdam (UP) with two joint professorships each. One leading scientist of IGZ was awarded an honorary professorship by Leibniz Universität Hannover.

For further plans concerning additional joint assignments with Hochschule für nachhaltige Entwicklung Eberswalde (University of Applied Sciences), Friedrich Schiller Universität Jena, FU Berlin and University of Potsdam, joint research labs with the Freie Universität Berlin and the Fachhochschule Erfurt see chapter 2.

Internationally, strong interactions have evolved with universities in Chile (Universidad de Talca), China (Ninxia Academy of Agriculture), Columbia (Universidad de los Andes Bogota, Pontificia Universidad Javeriana), France (Université de Bourgogne), Indonesia (Syiah Kuala University), Mexico (Universidad Autonoma de Queretaro) and the USA (University of Georgia).

Currently, 15 IGZ scientists contribute to the teaching programmes at six German partner universities in the fields of horticultural, environmental and life sciences. On average, 22 courses and lectures are offered by IGZ scientists per year, corresponding to 42 semester hours.

Collaboration with other domestic and international institutions

At IGZ, cooperative research projects are realised with scientists from 37 countries.

At a national non-university level, IGZ interacts with a number of Leibniz institutes (ATB, DIfE, IPB, IPK, and ZALF) and several Federal Research Centres (e.g. MRI, JKI, and TI; for details see chapter 2). Moreover, several cooperative efforts have been successfully established within the framework of research projects (e.g. WeGa, GsFunction, and Hortinlea). IGZ also participates in four Leibniz Research Alliances “Sustainable Food Production and Healthy Nutrition”, “Biodiversity”, “Bioactive Compounds and Biotechnology” and “Crises in a Globalised World”.

At the international level, IGZ participates in the horticultural workgroup of the European Plant Science Organisation (EPSO). In the context of the IGZ mission to improve horticultural practice for increasing the well-being of the populations of especially the world's poorer and developing countries, a number of projects receive public funding to address this issue, e.g. collaborative research with research institutions

in Africa (e.g. Kenya Agricultural Research Institute) or with international organisations and institutions (Food and Agriculture Organization of the United Nations FAO, *Deutsche Gesellschaft für Internationale Zusammenarbeit* GIZ, and Bioversity International).

Other collaborations and networks

Between 2012 and 2014, IGZ has received 67 scientific guests, eleven out of which stayed longer than three months. In the same time period, 43 scientists from IGZ stayed at research institutes abroad, among them five who stayed for longer than three months.

In total, more than 45 scholarship students (from Europe, Asia, Africa and Latin America) have stayed at IGZ over the last three years, funded mainly by DAAD, Erasmus, EU COST, foundations and domestic scholarship councils. In April 2015 e. g., IGZ had guests from Bangladesh, Cameroun, Egypt, France, Japan, Mexico, Russia, Syria and Vietnam.

5. Staff development and promotion of junior researchers

Staff development and personnel structure

At 30 September 2014, IGZ employed 119 people (103 fulltime equivalents), 47 of whom were scientists, 64 working at service positions and eight in the administration. Additionally, eleven student assistants, three trainees and five scholarship recipients worked at the institute. After the last evaluation in 2007, an increase in the staff appointment scheme (*Stellenplan*) by almost 10% was made possible. Since then, the institute has increased its core staff moderately and consolidated its structure. Half of the scientific staff is employed on temporary contracts, 15% is third-party funded (for details see Appendix 4). Approximately 75% of IGZ-staff is located at Großbeeren and 25% at Erfurt.

IGZ faces a turnover in staff in the coming years. Many scientists will retire between 2015 and 2020. IGZ sees itself as an attractive employer: In many cases, more than 100 persons respond to a job advertisement. The institute states that, in general, the number and quality of applicants is higher for positions related to basic research than for positions on horticultural issues. A problem is the recruitment of administrative staff able to work in an international environment and with modern data management systems.

Promotion of gender equality

Of the total number of scientists at IGZ in 2014, 55% were women. In executive positions, two out of seven scientists and two out of three junior group leaders were women (40%). Until 2019, according to the binding regulations of the Joint Science Conference (GWK) relying on DFG equal opportunity standards (cascade model), changes in the target female quota in scientific positions are not necessary for PhD students and non-executive positions. In leading positions, the currently open position as head of plant nutrition department make it possible to increase the female quota in leading positions.

According to the institute, equal opportunities for women and men, and a balanced work-family-life are primary aspects of the IGZ policy. IGZ is obligated to the "Research-Oriented Standards on Gender Equality" of DFG. The gender equality employment agreement and the equality plan regulate the tasks and the way the advisory board and equal opportunity staff work. In 2012, IGZ was awarded with the "*Audit berufundfamilie*" certificate.

Promotion of junior researchers

On average, IGZ hosts 25 PhD students (16 with an employment contract) and twelve Postdocs. From 2012-2014, 15 Master- and 16 PhD-theses were completed at the institute. The joint junior professorship with University of Potsdam was evaluated positively in 2014.

Doctoral candidates sign a PhD-agreement with IGZ, including the rights and responsibilities of both parties. A graduate student programme was established to ensure the overall quality of doctoral training. The institute offers students an insight into a wide spectrum of scientific work. This comprises training on methods, use of laboratory equipment and facilities, statistical evaluation of experiments, and writing of publications. It also includes in many cases the provision of funds to attend international meetings and visit laboratories and of seed money to initiate novel projects. Moreover, each PhD student has to choose a mentoring group (thesis committee) with two co-mentors, of whom at least one has to be a scientist at the institute. IGZ supports early scientific independence. In 2012, the institute established two junior research groups and one junior professorship.

Vocational training for non-academic staff

IGZ offers apprenticeship positions for a biological technician (since 2005), a chemical technician (since 2011), and a plant technologist (since 2014).

IGZ gives high priority to vocational training of non-academic staff and therefore established a training fund. Thus, funding of vocational training courses does not compete with other research related expenses. Between 2012 and 2014, a total of 85 staff took part in vocational training measures.

6. Quality assurance

Internal quality management

Research at IGZ is carried out in four Research Domains (RD), comprising several Research Areas (RA) and projects. According to the institute, each RA and each project has defined, verifiable objectives and scheduled milestones. The IGZ states that this enables permanent, effective research monitoring in meetings of the RD and RA, as well as by the Executive Board (internal) and the Science Advisory Board (external).

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.

Compliance with the DFG guidelines for good scientific practice is mandatory for each staff member at IGZ. An ombudsperson is appointed by the Research Staff Assembly who can be addressed in matters of scientific misconduct. Good scientific practice includes securing primary data. At IGZ, the complete data set generated during the course of any set of experiments is stored in a digital or an analogue archive for ten years.

Quality management by the Science Advisory Board and General Assembly

The Science Advisory Board (SAB) ensures regular evaluation of IGZ through audits, analogous to the external Senate evaluation. The recommendations and findings of these evaluations are included in a report to the General Assembly. These audits examine all Research Domains at IGZ and are performed regularly, at least once in-between the Senate evaluations.

The last audit took place in 2011/2012. Key topics were the scientific performance of the scientific units, the resulting research profile as well as the national and international visibility of the institute.

Implementation of recommendations from the last external evaluation

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 9 July 2008) as follows:

1. *IGZ should more strongly focus on specific biological model systems and implement these for working on relevant questions in horticulture. Thereby, the institute should follow up its path by bridging practice-orientated and basic research.*

According to IGZ, bridging practice-oriented and basic research is maintained as a prime characteristic of the institute. In addition to *Arabidopsis thaliana*, two further specific horticultural model systems – *Petunia* and tomato – have been increasingly used in the investigations. Moreover, model microorganisms are used for investigating plant-microbe interactions. Studying the bacterial plant communication from genes to ecosystems, the bacterial transcriptome, proteome and metabolome alterations of *K. radicincitans* are analysed. Progress in the understanding of regulatory mechanisms is immediately transferred to field application systems, after evaluation in model and greenhouse experiments. Projects cover basic (BoHiBak) to applied research (OptiBioPro). In the latter project, IGZ is developing, producing, and transferring a biological product in high demand in the horticultural and agricultural practice.

2. *IGZ should strengthen its work in the molecular biology area.*

According to IGZ, approaches in the field of molecular biology have been strengthened in diverse Research Areas (see also recommendation no. 7).

3. *IGZ should considerably increase third-party funding and the publication performance in peer-reviewed journals.*

Compared to the figures presented at last evaluation, IGZ increased third party funding. In the years 2012 to 2014, its share of the total budget was 14.3 %, 9.3 %, and 7.6 % (see

appendix 3). According to IGZ, a distinctly increased number of manuscripts has been successfully submitted to peer-reviewed journals. The enhanced quantity of peer-reviewed papers was accompanied by an increasing impact factor of the journals (see appendix 2).

4. *IGZ has a high potential to get even more visible as a research institute. Exemplarily, this can be achieved by institutionalised cooperation with partners selected by their scientific excellence and by participation or coordination of EU joint projects. Also, IGZ should specifically use cooperation in joint projects at the national level (e.g. DFG) to improve its research profile.*

According to IGZ, it promoted institutionalised cooperation with partners focussing on Europe, Asia and Latin America and some Africa countries, as well as with international institutions with a specific thematic focus interfacing with the IGZ research fields. Participation in and coordination of joint projects were realised at national and international levels (see chapter 4).

5. *IGZ should strengthen its cooperation with scientifically excellent universities. The planned joint assignment with the Institute of Biology of Faculty of Mathematics and Natural Sciences I of the Humboldt-Universität zu Berlin is of distinct importance for IGZ and should be realised as soon as possible. For promoting the support of young academics, IGZ should evaluate possibilities for joint, structured PhD student training with other universities.*

The joint assignment with Humboldt Universität zu Berlin has been realised in 2011. Currently, there are four joint assignments with universities, and two more joint assignments will be filled in 2015 (see chapter 4). Three additional joint assignments are part of IGZ's outlook for the next years. IGZ students have the possibility to participate in structured PhD courses in the collaborating universities (see chapter 5).

6. *The share of the temporarily employed, budget financed scientists has still to be increased. For fresh engagements, IGZ should increasingly take younger scientists experienced in getting grants and publishing papers. Furthermore, IGZ should try to increase the share of female scientists on the direction level. In addition, IGZ should be more strongly involved in training technical and gardening staff.*

The share of temporarily employed, budget-financed scientists was enhanced, resulting in a share of about 40% of all scientists (see appendix 4). The share of female scientists on the executive level has been increased as well. Furthermore, a training course for plant technologists was established to supplement apprenticeships for chemical and biology technicians (see chapter 5).

7. *An increase in budget financed scientists is recommended, particularly in the molecular biology area. A separate position is required for IT tasks.*

Additional positions in the molecular biology area were created, among them a technical assistant. Moreover, third-party funding allowed an increasing number of young academics with a molecular biology background to be recruited. Also, molecular biology

aspects reflect the teaching content of biology technicians trained since 2005 at IGZ. Since 2009, one full-time staff is employed in the IT department for the entire institute.

8. *In order to continue the positive development and to manage future requirements, IGZ's budget should be made more flexible. The funding agencies (Zuwendungsgeber) are therefore asked to implement the "programme budget" as the basis of funding and to abolish the fixed staffing plan. The funding should correspond to the justified needs for research. The Senate welcomes the willingness of funding agencies to increase the budget of IGZ.*

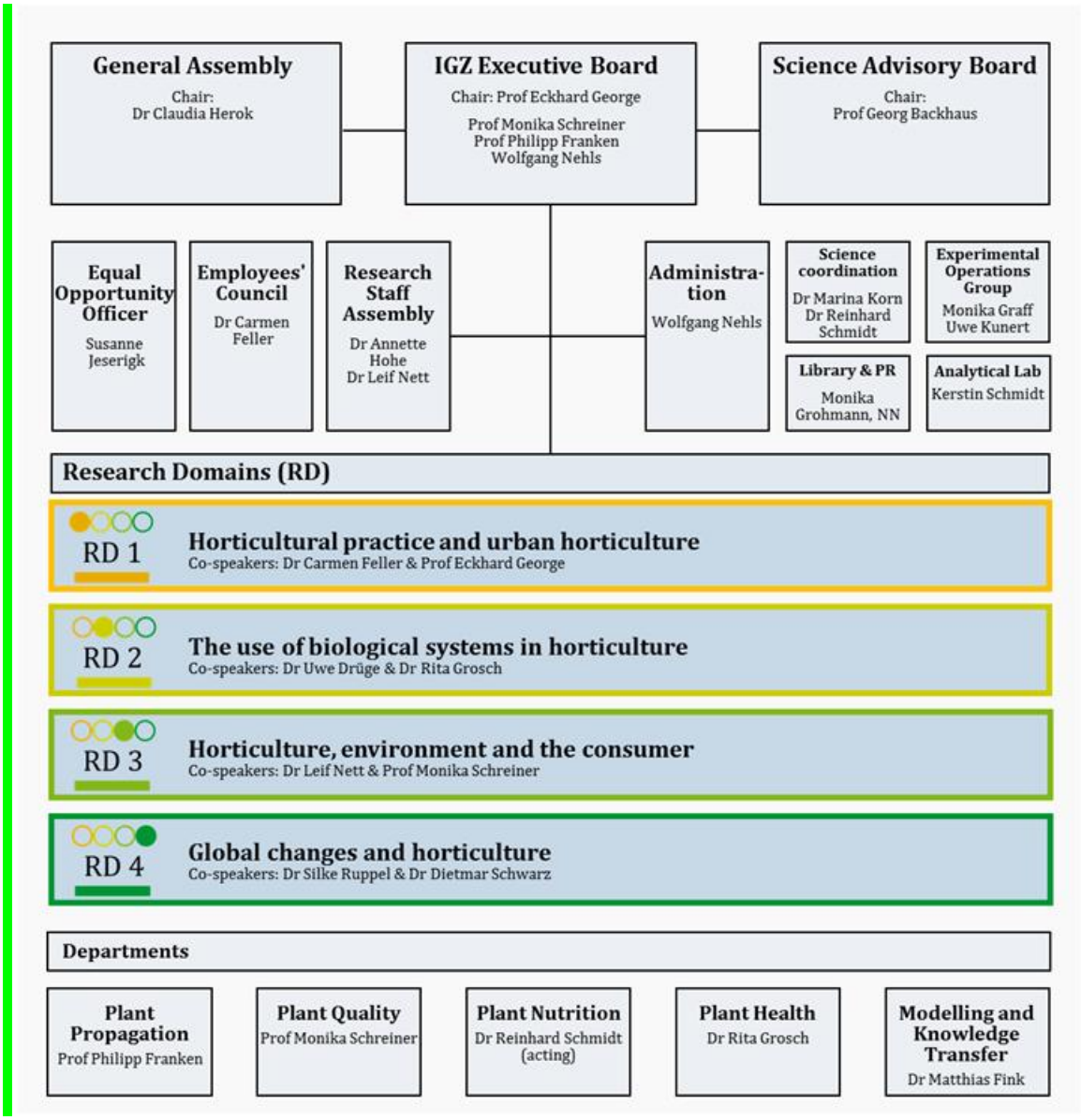
These recommendations have been realised by the funding agencies.

9. *It is recommended to shift the responsibility to the Ministries of Science and Education, as is generally the case for Leibniz institutions.*

In 2012, the Federal State of Brandenburg initiated a transfer of the functional responsibility from the Ministry of Infrastructure and Agriculture (MIL) to the Ministry of Sciences, Research and Cultural Affairs (MWFK). Under the jurisdiction of the Free State of Thuringia and the German Federation, IGZ is still associated with the ministries for agriculture.

Appendix 1

Organisational Chart



Appendix 2

Publications and patents

	Period		
	2012	**2013**	**2014**
Total number of publications	**152**	**167**	**174 (15)**
Monographs	7	5	8
Individual contributions to edited volumes	82	83	77
Articles in peer-reviewed journals [1)]	49	53	64 (15)
Articles in other journals	12	23	25
Editorship of edited volumes	2	3	1

Industrial property rights (2012-2014) [2)]	Granted/Held	Registered
Patents	3	1
Other industrial property rights	3	0
Exploitation rights/licences (number)	0	

[1] Online first publications and contributions that have been accepted for publication but not yet appeared are added in parenthesis.
[2] Concerning financial expenditures for revenues from patents, other industrial property rights and licences see Appendix 3.

Appendix 3

Revenue and Expenditure

Revenue		2012			2013			2014[1]		
		K€	% [2]	% [3]	K€	% [2]	% [3]	K€	% [2]	% [3]
Total revenue (sum of I., II. and III.; excluding DFG fees)		**12 175.5**			**16 136.9**			**15 283.6**		
I.	**Revenue (sum of I.1., I.2. and I.3)**	**8 862.2**	**100**		**11 729.6**	**100**		**11 060.6**	**100**	
1.	INSTITUTIONAL FUNDING (EXCLUDING CONSTRUCTION PROJECTS AND ACQUISITION OF PROPERTY)	7 599.5	85.7		10 638.8	90.7		10 216.2	92.4	
1.1	Institutional funding (excluding construction projects and acquisition of property) by Federal and *Länder* governments according to AV-WGL	7 599.5			10 638.8			10 216.2		
1.2	Institutional funding (excluding construction projects and acquisition of property) not received in accordance with AV-WGL									
2.	REVENUE FROM PROJECT GRANTS	1 262.7	14.3	100	1 090.8	9.3	100	844.4	7.6	100
2.1	DFG	86.2		6.83	101.9		9.34	57.8		6.8
2.2	Leibniz Association (competitive procedure)	43.4		3.44	73.2		6.71	15.5		1.8
2.3	Federal, *Länder* governments (BMBF, BMEL, MIL)	747.8		59.22	606.5		55.6	466.8		55.3
2.4	EU	117.0		9.27	83.0		7.61	63.2		7.5
2.5	Industry (Morel Diffusion; Bionorica AG, N.L. Chrestensen GmbH)	144.5		11.44	181.6		16.65	145.1		17.2
2.6	Foundations	0		0	0		0	31.1		3.7
2.7	Others (GIZ, President of the Russian Federation)	123.8		9.80	44.6		4.09	64.9		7.7
3.	REVENUE FROM SERVICES	0			0			0		
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.)									
II	**Miscellaneous revenue**	**2 064.4**			**749.1**			**2 636.1**		
IIa	Membership fees, donations, rental income	97.3			118.7			114.6		
IIb	Cash resources last year[4]	1 967.1			630.4			2 521.5		
III.	**Revenue for construction projects** (institutional funding by Federal and *Länder* governments, EU structural funds)	**337.5**			**3 658.2**			**1 586.9**		
IV.	**Revenue for research equipment** EU structural funds capital investment	**911.4**			**0**			**0**		

Expenditures		K€	K€	K€
Expenditures (excluding DFG fees)		**12 175.5**	**16 136.9**	**15 283.6**
1.	Personnel	6 052.4	6 181.0	6 304.3
2.	Material expenses	3 056.6	2 793.8	2 834.3
2.1	*Proportion of these expenditures used for registering industrial property rights (patents, utility models, etc.)*	0.1	3.4	0.2
3.	Equipment investments	1 741.4	265.4	2 063.1
4.	Construction projects, acquisition of property	504.1	4 231.0	1 392.3
5.	Cash resources[4]	821	2 665.7	2 689.6
DFG fees (if paid for the institution – 2.5% of revenue from institutional funding)		225.9	241.4	241.8

1) Preliminary data: yes
2) Figures I.1, I.2 and I.3 add up to 100%. The information requested here is thus the percentage of "Institutional funding (excluding construction projects and acquisition of property)" in relation to "Revenue from project grants" and "Revenue from services".
3) Figures I.2.1 to I.2.7 add up to 100%. The information requested here is thus the percentage of the various sources of "Revenue from project grants".
4) Self management fund in accordance with § 15 LHO Brandenburg and BHO, Liabilities for investments, cash balance project grants

Appendix 4

Staff

(Basic financing and third-party funding / proportion of women (as of 30 September 2014)

	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	**38.15**	15.33	**47**	51.06	**26**	65.38
Professors/Direct. (C4, W3 or equivalent)	0	0	0	0	0	0
Professors/Direct. (C3, W2, 15Ü or equivalent)	4	0	4	0	1	0
Academic staff in executive positions (A15, A16, E15 or equivalent)	2.75	0	3	0	1	0
Junior research group leaders/Junior professors/Post-Docs (C1, W1, A14, E14 or equivalent)	3	0	3	100	2	100
Scientists in non-executive positions (A13, A14, E13, E14 or equivalent)	22.7	18.49	26	38.46	13	46.15
PhD students (A13, E13, E13/2 or equivalent)	5.7	28.95	11	100	9	100
Service positions	**57.62**	4.34	**64**			
Laboratory (E9 to E12,upper-mid-level service)	14.85	6.73	17			
Laboratory (E5 to E8, mid-level service)	17.17	8.73	19			
Gardener (E9 to E12, upper-mid-level service)	3	0	3			
Gardener (E5 to E8, mid-level service)	11	0	11			
Workshops (E5 to E8, mid-level service)	2	0	2			
Workshops (E9 to E12, upper-mid-level service)	1	0	1			
Equal opportunities officer	0.2	0	1			
Library (E9 to E12, upper-mid-level service)	0.5	0	1			
Information technology – IT (E9 to E12, upper-mid-level service)	1.4	0	2			
Science coordination (E13, E14, senior service)	1.5	0	2			
Technical (large equipment, service) (E9 to E12, upper-mid-level service)	3	0	3			
Secretariat (E5 to E8, mid-level service)	2	0	2			
Administration	**7.25**	0	**8**			
Head of the administration	1	0	1			
Internal administration (financial administration, personell etc.) (E5 to E8, mid-level service)	2.5	0	3			
Internal administration (financial administration, personell etc.) (E9 to E12, upper-mid-level service)	3	0	3			
Building service (E1 to E4)	0.75	0	1			
Student assistants	**3.1**	**8.06**	**11**			
Trainees	3	0	3			
Scholarship recipients at the institution	**5**	0	**5**		**2**	
PhD students	5	0	5		2	
Post-Docs	0	0	0		0	

22 October 2015

Annex B: Evaluation Report

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

Contents

1. Summary and main recommendations

The Leibniz Institute of Vegetable and Ornamental Crops (IGZ) conducts application-related basic research with the aim of creating and improving the scientific fundamentals of horticulture for environmental protection, economic competitiveness and consumer interests. In the framework of its interdisciplinary research it addresses questions relating to plant quality, health, nutrition and propagation. As such, the institute deals with socially relevant and forward-looking themes and is successful in communicating its insights to the public, specialist and business spheres. IGZ's work is of great relevance to agricultural and horticultural practice in Germany and beyond.

In the last few years, IGZ has very convincingly improved personnel capacities in the research area. It is welcomed that the institute cooperates productively with universities in Berlin and Potsdam and is planning to continue strengthening its academic collaborative relations. Since the last evaluation, three new joint professorships have been established. Junior researchers are also promoted convincingly, and with regard to gender equality, even at leadership level, IGZ is clearly moving in the right direction. IGZ's spatial and experimental basis is excellent; special mention should be made of a new state-of-the-art phytotron (gas exchange greenhouse) at Großbeeren involving investment of six million euro.

After German re-unification, IGZ was founded as an institute with two sites. IGZ staff are organised into five disciplinary departments (four in Großbeeren, one in Erfurt). The four Research Domains, however, provide the effective working units, although the composition of the domains is not yet completely convincing. Performance in detail: Research Domain 3 with its three sub-units is rated as "very good to excellent". The overall performance of Research Domain 4 with its two sub-units is rated as "very good". Research Domain 1 is composed of two sub-units with only a few shares in research. In view of the relevance of transferring knowledge derived from horticultural insights to application contexts the Domain is also rated as "very good". By far the largest, Research Domain 2 has a heterogeneous performance and is, overall, rated as "good": Three sub-units performed indeed very convincingly whilst three sub-units are scientifically less successful. IGZ has recognised this fact and recently implemented a change of leadership in the relevant department to address this issue.

This and the many other positive changes that have occurred in the last few years, such as recruiting promising young researchers, establishing outstanding new infrastructures and the existing scope for filling vacant positions, must now be leveraged to quickly deal with the remaining deficits.

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

GENERAL CONCEPT AND PROFILE

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.
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.
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

RESULTS

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.

STRATEGIC WORK PLANNING FOR THE NEXT FEW YEARS

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.
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.

APPROPRIATENESS OF FUNDING, FACILITIES AND EQUIPMENT

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. It is pleasing to note that a positive trend seems to have set in in 2014 when third-party funding approaching € 2 million was acquired.

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.

COLLABORATION AND NETWORKING

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.

STAFF DEVELOPMENT AND PROMOTION OF JUNIOR RESEARCHERS

10. IGZ is called upon to use the usual competitive procedures for all the positions to be filled in the coming years.
11. It is recommended to increase the number of highly-qualified postdoctoral junior researchers by establishing third-party funded junior research groups, for example in the framework of the DFG's Emmy Noether Programme, or by introducing junior professorships.

QUALITY ASSURANCE

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.
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*.

2. General concept and profile

In accordance with its statutes, IGZ conducts application-related fundamental research into vegetables and ornamental crops, focussing on the growth and development of plants under different conditions and the impact of changing environmental conditions on horticultural production. It uses expertise in physiology, ecology and, increasingly, molecular biology to develop modern horticultural systems. Consequently, at IGZ agricultural scientists, biologists, geo-ecologists and food chemists successfully cooperate in interdisciplinary projects. By collaborating with external partners, additional expertise (e.g. in environmental science and medicine) is integrated. The institute addresses forward-looking topics of great relevance to society and is successful in communicating its insights to the public, specialist and business spheres. IGZ's work is of great relevance to agricultural and horticultural practice.

Organisationally, IGZ comprises five Departments (four mainly based in Großbeeren, one in Erfurt), delineated according to the institute's disciplinary expertise. The Research Domains, however, provide the effective working units, although the composition of the domains is not completely convincing – as was already determined at the last evaluation: they vary considerably in size (between six and 46 FTEs) and, in some cases, are composed of thematically, methodologically and qualitatively heterogeneous sub-sections (Research Areas, RA). This is particularly noticeable in Research Domain 2 (see Chapter 3). **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 IGZ has already undertaken the first major steps in this direction.**

Development of the institution since the last evaluation

Since the last evaluation, IGZ has very successfully expanded its collaboration with universities in Berlin and Potsdam (see Chapter 4) and recently recruited very promising young researchers (see Chapter 5). As a result, IGZ can now refer to some significant successes also in fundamental research. **In order to achieve greater international visibility it should, however, 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.** As recommended by the last evaluation, fundamental research in molecular biology has been introduced at the institute, partly as a result of a joint appointment with the University of Potsdam.

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.

After German re-unification, IGZ was founded as an institute with two sites. The scientific and infrastructural development of the Erfurt site has, however, lagged behind Großbeeren. Plans for a new greenhouse have been in existence for years whilst the recommendation to intensify cooperation with Friedrich Schiller University Jena, which was formulated at the last evaluation, has not advanced so far (see below and Chapter 4). These developmental difficulties are partly a result of deficits in the support provided by the responsible Ministry of Thuringia, the *Land* that hosts the Erfurt site. More support here is important to foster the development of IGZ. Against this background, it is highly appreciated that the Thuringian Authorities are planning to shift the responsibility for IGZ from the Ministry of Agriculture to the Ministry of Science (s. below and Chapter 6).

Results

As advocated at the previous evaluations by the German Council of Science and Humanities (2000) and the Leibniz Association Senate (2008), the number of publications has now reached an appropriate level – also in peer-reviewed journals. In the last three

years, an average of 60 peer-reviewed publications has appeared annually (i.e. 1.86 per scientific FTE). Nevertheless, IGZ still publishes significantly more articles in non peer-reviewed journals and edited volumes.

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. Also, this priority must be reflected in performance-based allocation of funding.

It is welcomed that staff at the institute are actively involved in various expert and advisory bodies, working groups and committees. IGZ is of major importance to the Federal Ministry of Food and Agriculture in particular, as demonstrated by the concomitant third-party income (see below). In this context, special mention should be made of its coordination of the Future Strategy in Horticulture and membership of the Scientific Advisory Board on Fertiliser Issues which secured an amendment to the Fertilisation Directive. Since 2008, IGZ's Executive Chairman has been a member of the groups advising the Research Directorate of the European Commission on FP7 and Horizon 2020 themes. He was also Vice President of the European Plant Science Organisation, EPSO, which significantly enhanced the institute's international visibility.

IGZ makes an important contribution to knowledge transfer and service through its publications in practice-related journals, which are usually open-access documents. Furthermore, the institute provides expert system software and decision support systems for vegetable growers which are accessed on a large scale. IGZ also cooperates successfully with various companies in the horticultural industry and plant breeders. In 2012, a spin-off was established (Geophilus Soil Mapping Service GmbH). This is considered a very good development.

It is welcomed that IGZ actively participates in the organisation and conceptual design of scientific events, which also find an international echo.

Strategic work planning for the next few years

IGZ has drawn up numerous plans and ideas for continuing its development essentially striving to strengthen its collaboration with universities (see Status Report, p. A-7f. and Chapter 4).

It is welcomed that IGZ's top priority is to fill the position of head of the Plant Nutrition Department, which has been vacant since the beginning of 2015, by a joint appointment with the University of Potsdam. The Review Board is of the opinion that this process must be expedited. It is very appropriate to establish a joint research group on "Plant Nutritional Genomics" in this department which, in line with IGZ's plans, would involve the University of Potsdam and the Max Planck Institute of Molecular Plant Physiology in Golm. According to IGZ, this can be done with no additional funding. Funding is also already earmarked for establishing a new professorship with the Eberswalde University for Sustainable Development ("Ecological Vegetable Production") which was jointly announced at the end of 2014. To foster closer links with this university of applied sciences with its pertinently interested students is very meaningful.

In addition to this, plans for a Joint Research Lab (Management of Fungal Biodiversity in the Rhizosphere) with FU Berlin and the declared application for a Leibniz Campus with the University of Potsdam are considered strategically expedient and thus welcomed.

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 expressly endorsed.

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. It is as yet unclear with which university the appointment should be made and if this is the most advantageous way to access the required scientific expertise. The institute should collaborate with relevant partner institutions and apply for third-party funding for the purpose.

The concept for the Joint Research Lab planned with Erfurt University of Applied Sciences should be enhanced in order to become of strategic importance for the entire institute (see Chapter 3, Research Area 2.4).

Due in large part to a recommendation made at the last evaluation to investigate possibilities for strengthening cooperation with Friedrich Schiller University Jena, IGZ has long been planning to establish a joint professorship for "Development Genetics of Plants" with Jena. A professorship of this kind would strengthen the expertise and methods of molecular genetics, hence, IGZ is strongly encouraged to realise this intent as soon as possible.

Appropriateness of funding, facilities and equipment

IGZ's institutional funding (2014: approx. € 10.2 million, see Status Report, Appendix 3) has increased by just under 50 per cent in comparison with the reference year at the last evaluation (2006). Thuringia, however, did not fulfil its financial obligations towards IGZ in accordance with the agreement between the Federation and the *Länder* to increase core budgets in 2012 and 2013. Thus, in this period, the institute accrued a cumulative deficit of approx. € 400k.

Both the previous evaluations by the German Council of Science and Humanities (2000) and the Leibniz Association Senate (2007) were distinctly critical of the third-party funding situation at IGZ. Despite the fact that the volume of third-party funding has doubled since 2007 and that the proportion of the total income has increased, **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**. **It is pleasing to**

note that a positive trend seems to have set in in 2014 when third-party funding approaching € 2 million was acquired. IGZ must raise significantly more funding from the DFG, in particular; the relevant revenue constantly falls below the fees paid by IGZ to participate in DFG funding programmes.

At 55 per cent of third-party research funding, the major third party funder in 2014 was the Federation (particularly project funding from the Federal Ministry of Education and Research and Federal Ministry of Food and Agriculture). EU funding accounted for 7.5 per cent resulting from IGZ involvement in four EU COST Actions and two other EU projects in the last few years. 17 per cent of competitively acquired third-party funding derived from industry, whereby apart from larger-scale projects by the German Federation of Industrial Research Associations (AiF), numerous individual projects were funded, in some cases involving very small sums. In future, more consideration should be given to the cost-benefit ratio when applying for such funds. This should be done on the basis of setting strategic priorities.

IGZ's spatial and experimental basis is excellent. In the last few years, it has been updated and extended, particularly at the Großbeeren site. It is pleasing to note that both the Federal Government and *Länder* which host the institute (especially Brandenburg) have provided substantial resources for this purpose. Special mention should be made of the new phytotron with its gas-exchange greenhouses which went into operation in 2014 and also received substantial funding from the EU. In this constellation, the Großbeeren site now has infrastructure facilities of a very high standard, both by national and international comparison. At the Erfurt site, plans for a new greenhouse have been in existence for years. Now, the requisite resources have been included in budgeting for the coming years. **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.**

3. Subdivisions of IGZ

RESEARCH DOMAIN 1 "HORTICULTURAL PRACTICE AND URBAN HORTICULTURE" (1.85 FTE RESEARCH AND SCIENTIFIC SERVICE, 0.25 FTE PHD STUDENTS, 4.1 FTE SERVICE STAFF) is composed of two Research Areas. In the period 2012 to 2014, a total of 130 articles in edited volumes and non-peer reviewed journals serving the purpose of knowledge transfer were launched (most of the authors work in other Research Domains). Third-party funding totalling € 34k largely derived from industry. Two Master theses were supervised. In view of the relevance of transferring knowledge derived from horticultural insights to application contexts, Research Domain 1 is rated as "very good". It is, however, not appropriate to run it as an independent Research Domain, as, in addition, it lacks critical mass. Therefore, it is recommended to restructure activities to achieve greater thematic sustainability (see Chapter 2).

RA 1.1 "Horticultural practice and production" focusses on bundling and processing results from other Research Domains and transferring them to horticultural practice. The

unit thus makes a significant contribution to IGZ's knowledge transfer (see also Chapter 2, Results). It achieves particular visibility with topics such as nutrient requirements and fertilisation strategies, greenhouse plant production systems and model-based control of field vegetables (e.g. asparagus bed temperature forecast). Independent research is not part of the unit's own portfolio.

RA 1.2 "Green city – Urban horticulture" was established in 2014. It is a still very small, mainly student-based group that addresses a very important topic. The focus is also on practical applications. Interesting projects are underway, but it is too early to assess them. It is already clear, however, that the current constitution of the group is not very promising. In order to do justice to the scientific potential and social relevance of the topic as a whole, the focus should shift away from urban gardening in the Berlin area to urban horticulture with an international perspective (e.g. food supply in mega cities in developing countries). Work of this kind could be profitably linked with Research Domain 4 "Global changes and horticulture". Should this unit continue to be developed in this way it must be significantly boosted in order to be successful.

RESEARCH DOMAIN 2 "THE USE OF BIOLOGICAL SYSTEMS IN HORTICULTURE" (13.3 FTE RESEARCH AND SCIENTIFIC SERVICE, 6.8 FTE PHD STUDENTS, 30.25 FTE SERVICE STAFF), with a total of 46 full-time equivalents, is by far the largest Research Domain. It is positive that the number of articles published in peer-reviewed journals between 2012 and 2014 increased from year to year (65 in total) whilst the number of publications in other journals (96 in total) dropped. Third-party funding fell slightly in this period and averaged a total of € 370k per year. It largely derived from the Federal and *Länder* Governments as well as industry. Only € 236k were raised from the DFG, which constitutes a large proportion of IGZ's overall funding from DFG but is still a far too modest amount. Five doctorates were completed.

Overall, Research Domain 2, because its performance is heterogeneous, is rated as "good": three Research Areas performed very convincingly whilst three Research Areas are scientifically less successful. IGZ has recognised the fact that the overall performance in RD2 must improve. Thus, in January 2015, in anticipation of a forthcoming change due to retirement, the responsibility for the department "Plant Propagation" was transferred to a member of IGZ's Executive Board. This new head of department is an established scientist who was appointed to a joint professorship with Humboldt Universität zu Berlin in 2011. It is well appreciated that he took the challenge to bring about a speedy and decisive improvement in scientific strategies and performances.

Whilst RA 2.1 "Control of adventitious root formation and further development of ornamental crops" conducts projects which are of notable relevance to applications and of major importance to the horticultural economy, scientifically they fall behind modern requirements and potentialities. It is urgently necessary to focus on research questions of fundamental interest. This will mean drawing on new methods (molecular biology) and technologies (plant transformation facility). Further potential for development will then lie in transferring these working results to other model systems (e.g. Cassava). RA 2.1 has acquired a DFG project together with the Leibniz Institute of Plant Genetics

and Crop Plant Research (IPK) in Gatersleben as well as three collaborative projects funded by Federal Ministries (together with Weihenstephan-Triesdorf University of Applied Sciences and Universität Hannover) and five industrial projects (with an average funding amount of almost € 11k). Some interesting articles have been published, although most of the lead authors were not IGZ staff.

RA 2.2 "Biological and technological fundamentals of seed and *in vitro* propagation" deals with technically sophisticated projects in the field of seed purification. The work on purifying Cyclamen seeds is of considerable economic interest as these seeds are very expensive. Thanks to sophisticated technology they have developed themselves, this group is now able to increase the germination rate. It is, however, still unclear whether these insights can be transferred to other model systems. Just as in the case of RA 2.1, it is recommended to extend the spectrum of methods and make greater efforts to derive application-related aspects from fundamental research. Merely three industrial projects with an average funding value of just under € 86k were acquired. The third-party funding and publication activities in this group leave room for improvement.

RA 2.3 "Biological principles for the optimisation of integrated pest management" focusses on the scientific basis of plant-pathogen interaction, particularly in soil-borne pathogens. In investigating the rhizosphere, the group has adopted a very important topic which is also of increasing interest to biotech companies. Both with regard to the questions addressed and the methods used, the work conducted here is state of the art and has the potential to become an IGZ flagship. The group's publication record is very good. It was involved in an ambitious BMBF collaborative project (PATHCONTROL). Further grants were also acquired, one from the DFG and four from the Federal Ministry of Food and Agriculture.

RA 2.4 "Principles of developing new genotypes for breeding of ornamentals and vegetables" addresses interesting, relevant questions in breeding research which are in great demand in practice. However, the group's technical facilities and methods are not sufficiently modern to facilitate the kind of new scientific insights that would generate high-ranking publications. The group has only acquired projects through the German Federation of Industrial Research Associations (AiF) and the Federal Ministry of Food and Agriculture. In April 2015, the head of the group took up a professorship at Erfurt University of Applied Sciences. Cooperation is now planned in the form of establishing a Joint Lab for "Horticultural Plant Breeding" (see Chapter 2). This link would be meaningful if it were to enhance the methodological palette.

RA 2.5 "Function of root-fungus interactions" investigates very interesting scientific questions on the basis of innovative methods. It can boast great expertise and convincingly collaborates with universities. The head of the group holds a joint professorship at HU Berlin. In line with recommendations, the work on *arbuscular mycorrhiza* was prioritised and has produced important results which have been published well. The acquisition of third-party projects must, however, be improved. Further interesting outcomes are expected from cooperation with Freie Universiät Berlin in the Joint Lab on "Management of Fungal Biodiversity in the Rhizosphere".

RA 2.6 "Molecular basis of plant performance" was established in 2013 under the leadership of the professor jointly appointed with the University of Potsdam. Since then, the group has developed excellently and its results have attracted a lot of attention. Third-party funding has been launched; the first DFG project was approved in 2014. The unit is a good example for the fruits of IGZ's insightful personnel strategy over the last few years. It has led to the recommended implementation of molecular biology at IGZ, which is rather unique in horticulture. The group's vast methodological expertise is expected to soon spill over into the institute as a whole, which holds great potential.

RESEARCH DOMAIN 3 "HORTICULTURE, ENVIRONMENT AND THE CONSUMER" (8.55 FTE RESEARCH AND SCIENTIFIC SERVICE, 2.5 FTE PHD STUDENTS, 13.9 FTE SERVICE STAFF) is composed of three Research Domains. With a total of 85 articles in peer-reviewed journals and a further 137 in other journals and edited volumes, the publication performance in Research Domain 3 between 2012 and 2014 was very convincing. In this period, third-party funding was comparatively high (a total of € 1.150k), but very largely derived from the Federal and *Länder* Governments. The only revenue from the DFG was € 3k in 2012 which means that the potential of this area is being seriously under-exploited. Six doctorates were completed. Overall, Research Domain 3 is rated as "very good to excellent".

RA 3.1 "Bioactive secondary plant metabolites in the interaction plant-environment" has strong analytical competence and addresses a very topical theme which is both scientifically sophisticated and socially relevant. Even if it may be rather too ambitious to expect the interesting results produced by this research to help solve health problems, it should be noted that they play an important role in connection with vegetable marketing issues and have been published in journals with high international visibility. It is recommended to continue exploiting the considerable potential of this topic by testing the hypotheses using genetic research approaches. On this basis, the group could become an IGZ beacon. The group has published in high-profile journals and has acquired substantial funding.

RA 3.2 "Function and importance of carotenoids and apocarotenoids" has been headed by a junior professor appointed jointly with the University of Potsdam since 2012. The RA addresses very interesting questions even though the application relevance is not as obvious as in RA 3.1. Thanks to excellent equipment, and with a special focus on regulatory mechanisms, relevant plant components are analysed. Here, too, as in RA 3.1, this group's work would benefit from genetic research approaches. The first grants of third-party funding have been raised from various research funders as well as industry. The number of articles published in peer-reviewed journals has increased continually.

Thanks to the ultramodern phytotron, RA 3.3 "Nutrient dynamics in horticultural crops" conducts outstanding, innovative research. Both in terms of themes and methods, projects are excellently structured and are of very great relevance to a multiplicity of important application aspects; the latter essentially relate to optimising costs and benefits in vegetable production and also embrace important environmental protection issues. In the period 2012 to 2014, six projects were conducted or launched for which third-party funding totalling over € 600k was acquired. The impressive results led to articles in

high-profile peer-reviewed journals. It is welcomed that RA3.3 was boosted by the addition of a junior research group in 2013.

RESEARCH DOMAIN 4 "GLOBAL CHANGES AND HORTICULTURE" (8.75 FTE RESEARCH AND SCIENTIFIC SERVICE, 1.15 FTE PHD STUDENTS, 9.37 FTE SERVICE STAFF) is composed of two Research Areas. Research Domain 4's publication performance is remarkable: in the period 2012 to 2014, it published a total of 48 articles in peer-reviewed journals as well as 77 articles in other journals and edited volumes. Its third-party revenue in the same period totalled € 904k and essentially derived from the Federal and *Länder* Governments. The domain collaborates with international partners in EU projects. Despite the basic potential, it received no funding from the DFG during these three years. This situation must change. Five doctorates were completed. Overall, the performance of Research Domain 4 is rated as "very good".

RA 4.1 "Control of micro climate for an efficient plant production" addresses a raft of extremely interesting themes and has had considerable success in publishing its interesting results in the last few years. The topics dealt with here, CO_2 reduction and irrigation, are the focus of scientifically sophisticated research projects and are also extremely relevant social challenges. Thanks to the ultramodern phytrotron, the research questions are investigated using the latest methods.

On the basis of ambitious research activities, RA 4.2 "Efficiency and stability of production systems" makes valuable contributions to solving highly-relevant application questions. The results not only flow into very good publications but also into helpful consultancy activities on the growth conditions of plants with the aim of enhancing the efficiency and stability of production systems.

4. Collaboration and networking

Collaboration with universities

IGZ collaborates with the University of Potsdam and Humboldt Universität zu Berlin – two joint professorships respectively (see Chapter 5) – as well as with Leibniz Universität Hannover, where one of the two Vice Chairs of the Executive Board holds an honorary professorship. IGZ's teaching activities at a total of six different German partner universities is greatly welcomed.

As already detailed and evaluated in Chapter 2 (Strategic work planning for the next few years), the institute's plans for its continued development essentially revolve around developing collaborative relations with universities. The measures envisaged to intensify relations with the universities in Berlin and Potsdam are very convincing (see Chapter 2). By contrast, the preconditions for implementing the planned collaboration with Friedrich Schiller University Jena (joint professorship for "Development Genetics of Plants") and with Erfurt University of Applied Sciences (Joint Lab for Horticultural Plant Breeding Research) are not yet adequately fulfilled and, for ensuring that they bolster research, have to be improved without delay.

Collaboration with other institutions in Germany and abroad

Cooperation with other Leibniz institutions working in related areas is very important to IGZ (see Status Report, p. A-16). The utilisation of complementary expertise in joint research projects generates good results. The institute also fosters fruitful partnerships with scientific institutions outside of the Leibniz Association. The Max Planck Institute of Molecular Plant Physiology in Potsdam-Golm, for example, is highly interested in the topics and research work at IGZ, as demonstrated by the planned joint research group on "Plant Nutritional Genomics" with IGZ and the University of Potsdam (see Chapter 2).

IGZ actively collaborates with partner organisations in regions outside of Europe in which horticultural topics are of existential importance. The number of visitors from non-European countries is consistently large, and numerous members of IGZ's staff have visited institutions outside of Europe. In the last three years, the institute supervised a total of five international scholarship students. It thus made a relevant contribution to internationalising scientific training.

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. With its excellent facilities, IGZ is also an attractive partner for EU cooperation projects (see Recommendation 8). In this context, it is highly welcomed that IGZ's Director is a member of European Commission advisory groups.

5. Staff development and promotion of junior researchers

Staff development and personnel structure

On the reporting date of 30 September 2014, 119 individuals were employed at IGZ (excluding auxiliary staff, trainees and scholarship-holders; see Status Report, Appendix 6). As such, the number of staff has increased slightly in comparison with the relevant date at the last evaluation (2006: 105 individuals in total). With a proportion of 52 per cent of fixed-term contracts in the scientific area, IGZ has achieved an appropriate balance whereby only 15 per cent of scientific positions were covered by third-party funding. Personnel costs for laboratories and gardening are high: in comparison with the 47 individuals working in research and scientific services, the service sector employs 64 (excluding eight individuals working in administration).

In the last few years, IGZ has recruited very good young researchers. The recommendation made at the last evaluation (2008) to establish a second joint appointment with Humboldt-Universität zu Berlin was completed in 2011. It is pleasing to note that in 2012 and 2013, one subsequent joint appointment was made to a professorship and one to a junior professorship at the University of Potsdam, which sustainably strengthen IGZ's profile. It is now necessary to speed up the process of appointing a successor to the position of head of IGZ's Plant Nutrition Department which has been vacant since January 2015 (see Chapter 2). At the time of the evaluation visit, however, this position had still not been announced.

As a large number of staff will reach retirement age in the coming years, IGZ will be faced with a major upheaval in personnel: by 2022, 19 positions will become vacant at the entire institute, including eight senior public service positions. Pleasingly, the binding staffing appointment plan was abolished, which means that IGZ now has the flexibility it needs to fill vacant positions strategically and to continue consolidating the scientific side. **IGZ is called upon to use the usual competitive procedures for all the positions to be filled in the coming years**.

Talks with members of staff at the institute revealed a very high degree of both motivation and work satisfaction which is the achievement of the institute's director and his leadership team. All IGZ staff have sufficient opportunities to enhance their qualifications at the universities in the area and beyond.

Promotion of gender equality

IGZ takes gender equality very seriously: with the overall proportion of women in research and scientific services at 55 per cent, it has already achieved an exemplary balance between men and women (see Status Report, p. A-17 and Appendix 4). The institute's efforts to implement the binding cascade model, also with regard to ongoing and upcoming appointments at senior management level, are welcomed. Currently, four of the ten leadership positions are held by women (see Status Report, Appendix 4).

Due to its impressive efforts to combine family and working life, IGZ was awarded the "Audit *berufundfamilie*" certificate in 2012. It is welcomed that the institute is seeking a re-audit in 2015.

Promotion of junior researchers

Junior researchers are very well trained and supervised at IGZ (see Status Report, p. A-18). The Graduate Student Programme is high quality but should be more ambitious in terms of scientific excellence. For this purpose, regular scientific retreats and lectures series could be held to which internationally recognised senior researchers were invited. It is welcomed that IGZ's doctoral candidates have access to the Potsdam Graduate School (POGS).

Postdocs are also supported very well. By establishing two junior research groups and one junior professorship in 2012, IGZ has chosen the right path. **It is recommended to increase the number of highly-qualified postdoctoral junior researchers by establishing third-party funded junior research groups, for example in the framework of the DFG's Emmy Noether Programme, or by introducing junior professorships.**

Vocational training for non-academic staff

It is welcomed that non-scientific staff are regularly offered the opportunity to participate in individual training activities and that IGZ has established a special training fund to this end. At the time of the evaluation visit, three trainees were employed at IGZ.

6. Quality assurance

Internal quality management

At IGZ, the advisory and steering mechanisms used for quality assurance must become more effective. The internal quality assurance is complicated by the fact that responsibility for personnel is located at departmental level whilst responsibility for budgetary matters resides with the Research Domains (or the Research Areas; see Status Report, p. A-3). **It is recommended to simplify IGZ's management structures and introduce a clearer allocation of responsibilities.**

IGZ has introduced performance-based funding allocation, but it is not yet sufficiently directed towards improving the institute's scientific visibility. It should also include elements designed to increase the number of applications submitted for competitive third-party funding. Especially with regard to DFG applications, IGZ should further exploit its potential (see Chapter 2).

Quality management by the Scientific Advisory Board and Supervisory Board

The Scientific Advisory Board supports IGZ constructively and critically. It meets twice a year and conducts the standard Leibniz Association audit between the external evaluations. More attention should be paid to its critical remarks in future.

As is usual at Leibniz institutes, the members of the Scientific Advisory Board hold their positions for a statutory maximum of two four-year terms of office. In practice, however, the period is sometimes significantly longer. In future, the actual term of office must comply with the regulations stated in the statutes.

At IGZ, the General Assembly plays the role of Board of Trustees. According to the statutes, the SAB chair is a voting member of the Board of Trustees. In order to make a clear distinction between the functions of supervision and scientific advice, this regulation must be changed. As is usually the case at Leibniz institutions, the SAB chair should be a non-voting member of the Board of Trustees in a purely advisory capacity.

In accordance with the rules governing the Leibniz Association (AV-WGL[1]), **the Federal Government must have the same number of votes on the Supervisory Board as the responsible *Länder***.

It is welcomed that, as recommended by the Leibniz Association Senate, responsibility in Brandenburg has been transferred to the Department of Science. The change planned in Thuringia should now follow as soon as possible. At federal level, responsibility still resides with the Ministry of Food and Agriculture.

Implementation of recommendations from the last external evaluation

The institute has made a conscientious effort to implement most of the recommendations made at the last evaluation (see statement by the Senate of the Leibniz Association on IGZ of 9 July 2008, p. 3f, as well as the IGZ Status Report of 1 June 2015, p. 19ff.).

[1] Administrative Agreement between the Federal and *Länder* Governments with regard to the joint funding of member institutions of the Leibniz Association.

There are, however, some important issues on which IGZ must continue to work intensively:

1) In accordance with recommendations, IGZ has boosted its research with selected biological model systems. The conditions are now very good for mediating between practice-relevance and fundamental research, but for this purpose the institute must work on improving its fundamental research and on strengthening the research base of knowledge transfer.
2) As recommended, IGZ has boosted work in the area of molecular biology but it is still behind in a number of areas where its presence would be a valuable asset in order to generate internationally visible research results.
3) Although IGZ has increased the figures for third-party funding and particularly its publication performance in refereed journals in comparison with the reporting period for the last evaluation, neither of these performance parameters has yet reached the expected level . As detailed in Chapters 2 and 6, IGZ must work intensively on improving these areas.
4) IGZ is still not fully exploiting its potential to become more visible as a research institution although, as recommended, institutionalised collaborative relations have been developed and are having positive effects. IGZ must, however, continue to increase its efforts to participate in EU cooperation projects and be involved in nationally-based research alliances.
5) As recommended, collaboration with universities has been intensified. A joint appointment with Humboldt-Universität zu Berlin was established in 2011. A junior professorship and a professorship at the University of Potsdam followed in 2012 and 2013. Further joint appointments with universities are planned or in the pipeline (see Chapter 2). IGZ's Graduate Student Programme is high quality but should be aligned even more closely with international standards (see Chapter 5).
6) In accordance with recommendations, the proportion of researchers on fixed-term contracts has been increased. The institute has managed to recruit highly-qualified new scientific staff. As recommended, the proportion of women at leadership level has significantly increased. Training and continuing education for technical and gardening staff has been improved.
7) As recommended, new positions in the field of molecular biology have been created. A dedicated position for IT has been established.
8) The funders have facilitated greater budgetary flexibility by abolishing the binding staffing appointment plan. Between 2006 and 2014, IGZ's institutional funding grew by just under 50 per cent, from approximately € 6.9 million to approximately € 10.2 million.
9) As recommended, Brandenburg transferred responsibility for IGZ to the relevant Department of Science, as is common practice in the Leibniz Association. In Thuringia, the equivalent change of department is planned. So far, this recommendation has not been implemented at federal level (see Chapter 6)

Appendix

1. Review Board

Chair (Member of the Leibniz Senate Evaluation Committee)

Andreas **Weber**	Department of Plant Biochemistry, Düsseldorf University, Germany

Deputy Chair (Member of the Leibniz Senate Evaluation Committee)

Harry **Vereecken**	Institute of Bio- and Geosciences, Forschungszentrum Jülich, Germany

Reviewers

Andreas **Bürkert**	Organic Plant Production & Agroecosystems Research in the Tropics and Subtropics, University of Kassel, Germany
Natalia **Dudareva**	Department of Biochemistry and Department of Horticulture and Landscape Architecture, Purdue University, West Lafayette, USA
Erwin **Grill**	Center of Life and Food Sciences Weihenstephan, Technische Universität München, Germany
Wilhelm **Gruissem**	Group of Plant Biotechnology, Swiss Federal Institute of Technology Zurich, Switzerland
Henning **Kage**	Institute of Crop Science and Plant Breeding, Kiel University, Germany
Hans-Peter **Kaul**	Department of Crop Sciences, University of Natural Resources and Life Sciences, Vienna, Austria
Leo **Marcelis**	Horticulture & Product Physiology Group, Wageningen University, Netherlands
Cathie **Martin**	Department of Metabolic Biology, John Innes Centre, Norwich, UK
Karin **Schwarz**	Institute of Human Nutrition and Food Science, Kiel University, Germany

Representative of the Federal Government

absent with apologies	Federal Ministry of Education and Research, Germany

Representative of the Länder Governments

absent with apologies

2. Guests

Representative of the relevant Federal government department

Thomas **Schmidt**	Federal Ministry of Food and Agriculture, Germany

Representatives of the two relevant Land *government departments*

Claudia **Herok**	Ministry for Science, Research and Culture of the State of Brandenburg, Potsdam, Germany
Elke **Mohnhaupt**	Thuringian Ministry of Infrastructure and Agriculture, Erfurt, Germany (only 9 June 2015)

Representative of the Scientific Advisory Board

Georg F. **Backhaus**	Julius Kühn-Institut, Federal Research Centre for Cultivated Plants, Quedlinburg, Germany

Representative of the Leibniz Association

Ulrich **Bathmann**	Leibniz Institute for Baltic Sea Research, Rostock, Germany

3. Representatives of partner institutions

Robert **Seckler**	University of Potsdam, Vice-President for Research and Junior Academics, Potsdam, Germany
Bernhard **Grimm**	Humboldt-Universität zu Berlin, Deputy Dean for Research, Faculty of Life Sciences, Berlin, Germany
Mark **Stitt**	Max Planck Institute of Molecular Plant Physiology, Potsdam-Golm, Germany
Brian **Thomas**	University of Warwick, UK
Hartmut **Weimann**	German Horticultural Producers Organisation (*Zentralverband Gartenbau*), Bonn, Germany

20 November 2015

Annex C: Statement of the Institution on the Evaluation Report

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

The Leibniz Institute of Vegetable and Ornamental Crops (IGZ) thanks the members of the evaluation board, the guests, and the staff of the Leibniz Association's evaluation office for the fair, competent and professional review process. The IGZ is very grateful for the positive and constructive evaluation report. The report endorses the key elements of the IGZ future development strategy and provides a number of clear recommendations for the coming years.

The report concludes that the IGZ addresses forward-looking topics of great relevance to society. It also states that the IGZ actively collaborates with partner organisations in regions outside of Europe in which horticultural topics are of existential importance. We are grateful indeed for the strong endorsement of our plan to apply for additional funds from Federal and Länder Governments to support work on “Biodiversity and Sustainability” with a planned joint appointment with Freie Universität Berlin. We will also follow the useful recommendations by the evaluators concerning our work on urban horticulture and on development economics in horticulture.

We are delighted that the report praises the high quality of much of the research at the IGZ. The performance of three out of four research domains of the IGZ is rated as "very good" or "very good to excellent". We are thankful that the reviewers observed and mentioned the very high degree of both motivation and work satisfaction of our staff, and for the very positive appraisal of our newly appointed young researchers by the evaluators.

The IGZ welcomes the recommendations put forward by the review board as clear directions for areas in which the institute's work could be further improved. One of our research domains was rated as "good", due to the uneven quality of research groups in this domain. We appreciate that the evaluators praised some groups in this research domain for their excellent development and their implementation of molecular biology, so that they could become flagships of the institute. The evaluators pointed out that the relatively weaker groups are mainly located at the IGZ Erfurt site.

The IGZ has faced this situation by appointing a new department head at Erfurt, intensifying cooperation with the Friedrich Schiller University Jena and other neighbouring academic institutions, and by setting up a Joint Research Laboratory at the site (starting 2016). The shift of responsibility in Thuringia for the IGZ from the Ministry of Agriculture to the Ministry of Science is currently under way and will support us in our aim to more strongly integrate the IGZ with excellent research partners in Thuringia.

As recommended by the report, we will fill the position of Plant Nutrition Department head, as part of a joint research group on “Plant Nutritional Genomics” with the University of Potsdam and the Max Planck Institute of Molecular Plant Physiology. We will establish the joint professorship for “Development Genetics of Plants” with the Friedrich Schiller University Jena, the new professorship with the Eberswalde University for Sustainable Development on "Ecological Vegetable Production", and the two new Joint Research Laboratories. All of these plans have been pursued actively by the IGZ since the evaluators’ visit. We are confident that all of these plans can be realised in the near future (by the end of 2016).

Following the recommendations, we will place more emphasis on fundamental aspects of applied problems and use molecular biology approaches more often. This will help us to further increase third-party funding, with an emphasis on significantly more funds from the DFG. Since the evaluators' visit, a temporary position for a Principal Investigator has been granted by the DFG for work at the IGZ.

Twenty-three years ago, the IGZ started as a newly formed institute aspiring to regional importance in horticulture. The current recommendation of the interdisciplinary evaluation panel for the IGZ to become a confident international leader and to partner with the most distinguished institutions in its field is, in our view, the result of our very successful development in the Leibniz Association. Also, these high expectations of the expert panel strongly motivate IGZ staff and leadership to use our excellent opportunities in the future with even more confidence, visibility and success.