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Vermi-compost in agricultural production in Bangladesh

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ABSTRACT

Now a day vermi-compost has appeared as one of the most popular organic fertilizer used for organic agriculture. The study was conducted in Mithapukur,in Rangpur, Khulna Sadar in Khulna and Daudkandi in Cumilla through the questionnaire survey, focus group discussion, key informant interview and case study documentation. The total of 90 respondents from three districts was interviewed where 60 were experimental respondents and 30 were from control respondent groups. From each districts, 20 experimental and 10 control respondents were selected. According to the producer groups of different locations, an average production cost for per kilogram of vermi-compost is about Taka 7 to 8 and sell it taka 12 to 20 per Kg. Rice is the main crop of the respondents and 100% of them are engaged in rice cultivation. Besides, winter vegetable, potato and wheat are more prominent crop cultivated by the respondents. There 87% respondents of the experimental group are now applying vermi-compost in their vegetable plots, 30% in rice fields and 17% in other crops. In an average, they apply more than 2 kilogram per decimal in rice fields and >1.5 kg per decimal in vegetable fields. According to 62% respondent of experimental group and 27% of control group vermi-compost could increase water holding capacity of soil by 30% or above. About 48% respondents of experimental group stated that vermi-compost increase resistance to disease attack in the plants and also increase number of flowers as well as crop production.

INTRODUCTION

The conventional agriculture of Bangladesh after green revolution heavily depended on chemical fertilizers and pesticides causing several problems to human health and the environment. As a result, food safety has now become a big issue. Moreover, the cost of agriculture has increased manifold with declining yield levels and growing dependence on market for purchase of chemical fertilizers and pesticides. Hence the most urgent step is application of bio-products in order to ensure better and safe environment without any reduction in yield of crops.

Gradually urbanization is increasing in Bangladesh; around 30% of people live in urban areas. Approximately 16,380 tons per day of waste is generated in the urban areas of Bangladesh. If it could reuse some of this as an ingredient of organic fertilizer production, this may reduce the cost of raw materials on one side and on the other hand relieve the burden of improper waste dumping.

Concern over sustainability of agriculture and food security in Bangladesh is mounting due to the deteriorating land quality, declining yield, and increasing population. To increase crop yield from the scarce arable land, farmers are intensifying land use, increasing the use of inorganic fertilizers, pesticides, irrigation equipment, and other technologies.

Declining productivity due to soil degradation and a good soil should have organic matter content more than 3.5%, but in Bangladesh most of the soils have less than 1.7%, and some soils have even less than 1% organic matter.

Organic agriculture as a holistic production management system, avoids usage of synthetic inputs and genetically modified organisms, minimizes pollution of air, soil and water, and optimizes the health and productivity of

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interdependent communities of plants, fisheries, animals and people. In recent years some organic agricultural technologies have proven to be effective technologies and accepted by the farmers. Until now, however, Bangladesh agriculture has not been able to benefit from the growing global organic market, and they have even failed to create a good domestic market of organic foods.

Vermi-compost is a nutritive 'organic fertilizer' rich in NKP (nitrogen 2-3%, potassium 1.85-2.25% and phosphorus 1.55-2.25%), micronutrients, beneficial soil microbes like 'nitrogen-fixing bacteria' and'mycorrhizal fungi' and are scientifically proving as 'miracle growth promoters & protectors' (177). Kale and Bano (108) reports as high as 7.37% nitrogen (N) and 19.58% phosphorus as P_2O_5 in worms vermicast. Now a day vermi-compost has appeared as one of the most popular organic fertilizer used for organic agriculture. A number of researchers throughout the world have found that the nutrient profile in vermi-compost is generally higher than traditional compost. In fact, vermi-compost can enhance soil fertility physically (aeration, porosity, bulk density and water retention), chemically (pH, electrical conductivity and organic matter content) and biologically (increase growth and yield production of plants).

Considering the above fact the study was conducted to know about the status of vermi-compost production, use and people's perception in Bangladesh. Therefore the objectives of the study were to know about the current technology used for vermi-composting, to know about the current uses of vermi-compost in agriculture sector and to know about the perception of vermi-compost users in Bangladesh.

METHODOLOGY

The study emphasized on three major aspects including the vermi-compost technologies practiced, use and perception of people. The survey collected mainly quantitative information focusing at the household level. The qualitative information was collected from individual and community levels, by using focus group discussions and in-depth interviews and case studies to complement and deepen the quantitative survey work.

Sampling

Sampling framework for questionnaire survey. The researcher shared the objectives of the study with the senior level scientists of Bangladesh Agricultural Research Council (BARC), senior officials of DAE and representatives of NGOs who were engaged in vermi-compost production and use.

After discussion with the experts, it was decided that the sample size had to cover three upazilas of three districts, where a good number of people are practicing vermi-compost. In addition, 50% control respondents were selected from the same area.

Finally, from 20 respondents from experimental group and 10 respondents from control group were selected from each of the districts. Thus totally 60 experimental and 30 control respondents were selected.

Table 1
Sample size for the baseline survey.

Types of respondents	Cumilla		Khulna		Rangpur	
	Experimental	Control	Experimental	Control	Experimental	Control
Vermi-compost user	16	-	16	-	16	-
Produce and use vermi-compost	2	-	2	-	2	-
Vermi-compost seller	2	-	2	-	2	-
Total	20	10	20	10	20	10

Site selection

Sites for questionnaire survey were selected on the basis of expert opinion, existence of farmers, high concentration and access. Sites like selected Mithapukur upazila of Rangpur district, Khulna Sadar upazila of Khulna district and Daudkandi upazila of Cumilla district were selected for this study.

Data analysis

Data were analyzed using Statistical Package for the Social Sciences (SPSS) version 16.0 and were subjected to one way ANOVA and correlation analysis. Considering the treatments as independent variables, the means were separated using Duncan test with a significance level of $p< 0.05$.

RESULTS AND DISCUSSION

Production technology for vermi-compost

There are three methods which are used for producing vermi-compostin Bangladesh. These are: i) Ring method, ii) Chari method and iii) Bed/Tank/Pit method.

Raw materials for vermi-composting

Composter earthworms, vegetable wastes, banana stem peels, coir pith, leaves, sugarcane trash, grasses or husk, and any moistened organic material etc., kitchen wastes, municipality wastes, fruit skin and seeds (rejected), refused cattle food, saw dust, biogas slurry, fish scraps, sewerage slurry, sugarcane waste, soft plant residue, cow/chicken/duck/goat dung, livestock and fish intestine, azolla, water hyacinth etc.

Production system

Estimated quantity of mixture for one Chari is maximum 160 kg (green weight). All the organic wastes were mixed and choped together, wraped/filled in a black polythene sheet/bag and kept in a dry place for 7-8 days. After fermentation, the whole material was left in an open space till the moisture percent reduced up to 50-60%. The cow-dung was partialy decomposed for 7-10 days.

In the meantime, a shed/house were constructed where the chari was kept. After completion of fermentation and decomposition of the ingredients, cow-dung and kitchen or vegetable market wastes in 3:1 ratio were mixed, placed them in 8 chari equally, added 200 *Eisenia fetida* earthworms (both clitellated and non-clitellated) in each of the chari. About 40 to 50% moisture was maintained in the materials. The container was covered with gunny bags to protect the earthworms from light as earthworms like to feed and stay in a dark place.

The mixture was checked in every 1-2 days for water. If needed, some water was added in it. Before placing earthworms in the chari, drain was made around the shed/house for protecting ant, insects etc. Earthworms were put on the top of the composted materials. Immediately after introduction of worms, first lot of vermi-compost were ready within 60-70 days. Gradually with bacterial decomposition and increase in numbers of worms, vermi-compost was ready in 30-40 days only. It is estimated that 1kg of earthworms (i.e. nearly 1000 adult *Eisenia* species worms) could produce 10kg casts in 60-70 days.

Collection of vermi-compost

When top layers of mixed materials appeared somewhat dark brown, granular as if used dry tea leaves have been appeared over the layer, the vermi-compost was ready to collect.

Vermi-compost sieving

Collected vermi-compost was dried, passed through a 5 mm sieve to recover the cocoons, young worms, and unconsumed organic material. The screened vermi-compost was bagged and used as required.

Sales price

According to the producer groups of different locations, an average production cost for per kilogram (Kg) of vermi-compost was about Taka 7 to 8 and usually sold it taka 12 to 20 per Kg.

Table 2
The demographic profile of the respondents both experimental and control group.

Catagories		Experimental group				Control group			
		Rangpur	Cumilla	Khulna	All	Rangpur	Cumilla	Khulna	All
Avg. age (yr.)		33.5	35.8	37.6	35.6	41.2	37.9	38.9	39.3
Household size		3.60	4.05	4.10	3.90	3.90	3.50	3.70	3.70
Gender ratio among household	Female	33	42	40	115	15	17	19	51
	Male	39	39	42	120	24	18	19	61
Sex	Female	19	8	14	41	8	1	7	16
	Male	1	12	6	19	2	9	3	14
Maritual %		100	100	100	60	100	100	100	30
Education %	Illiterate	5	0	5	3.3	10	0	0	3.3
	Can Sign only	25	10	5	13.3	10	10	20	13.3
	Primary	55	60	65	60	60	50	70	60
	Secondary	15	30	25	23.3	20	40	10	23.3
Occupation %	Agriculture	100	80	80	86.7	100	90	80	90
Land Capital (decimal)	Cultavable	114.95	35.5	136.2	95.6	107.6	40.8	132.7	93.7

Table 3
Agricultural farming practice of the respondents.

Name of the crops	Cumilla		Khulna		Rangpur	
	Experimental	Control	Experimental	Control	Experimental	Control
Rice	20	10	20	10	20	10
Wheat	8	3	0	0	9	5
Maize	5	4	0	0	5	3
Potato	16	9	9	5	14	8
Mustard (Shorisha)	5	3	13	6	6	3
Summer vegetable	3	2	20	6	18	10
Winter vegetable	20	10	20	10	18	10
Banana	0	0	0	2	7	3

Demographic profile of the respondents

The respondents were engaged in diverse occupations, varies from agriculture to day labour, service holder, small businessmen, fisherman and share cropping. Among the despondences 68.3% and 53.3% respondents were housewives in experimental and control group, respectively. Besides, they also help their family members in their crop lands 86.7% and 90% of the experimental and control group respectively.

Agricultural farming practice

Rice was the main crop of the respondents and all of them are engaged in rice cultivation. Besides, winter vegetable, potato and wheat are more prominent crop cultivated by the respondents. None of the respondents of Cumilla and experimental group of Khulna produced banana. Maize cultivation was expanding in Cumilla and Rangpur areas. On the other hand, none of the respondents of Khulna grew wheat and or maize. However, above 60% of the respondents of Khulna produced mustard.

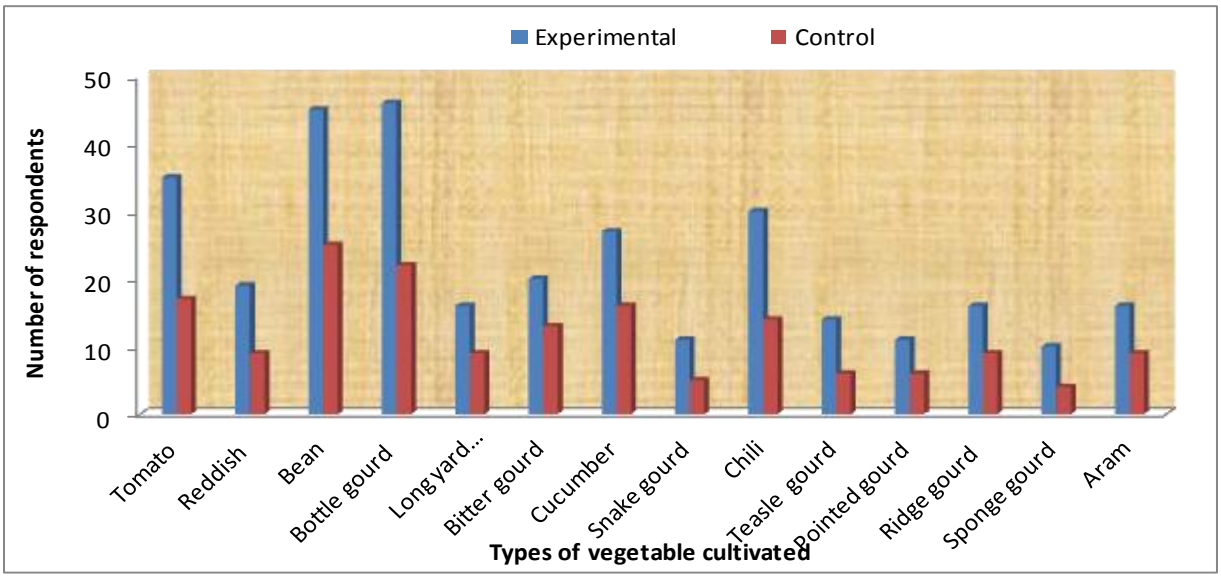

Figure 1
Types of vegetable cultivated by the respondents

All of the respondents grew winter vegetable in their crop fields. Summer vegetable cultivation was also getting popularity in the study areas. The Department of Agricultural Extension (DAE) along with research institutions and private business companies are trying to introduced seeds and technologies of summer vegetable. All most all of the respondents of Khulna and Rangpur mentioned that they were producing summer vegetable. However, as most of the respondents of Cumilla were engaged in floodplain aquaculture and have limited access to crop land during summer and monsoon, only few of them (about 25%) could grow vegetable in the summer season.

The respondents use to cultivate range of winter and summer vegetables in their crop fields, including, tomato, reddish, bean, bottle gourd, long yard bean, bitter gourd, cucumber, snake gourd, chili, teasle gourd, pointed gourd, ridge gourd, sponge gourd, aram, etc.

In Rangpur region more than 80% of the respondents of both categories cultivated bottle gourd and bean (Table 4). The picture was also similar for Cumilla region. However, as soon as water recedes from the floodplains of Cumilla, farmers started cultivating tomato over there. About 90% of the respondents of experimental group and 80% of the respondents of control group cultivated tomato in Cumilla (Table 4). Other major crops of Cumilla were bean, chili and cucumber.

In Khulna region, about 70% of the respondents of experimental group and 80% of control group cultivated country bean, more than 60% of both groups cultivated tomato, chili and bottle gourd. About 50% of the respondents of Khulna also cultivate bitter gourd.

Use of fertilizer

According to the needs of plants, the respondents mostly appleid Nitrogen, Phosphorus and Potash (N, P, K) fertilizers. All the respondents used Urea and TSP fertilizer during cultivation of any crops. However it is observed in the study that all the respondents of experimental group applied MP in their rice plots, 43% in their vegetable fields and about 60% used in other crops. In the same time, about 93% of the control group respondents have used MP in their rice fields, 50% in their vegetable plots and 40% in other crop lands. In recent years, scientists are also giving their opinion to use Zip sum and Boron fertilizer. It is also reflected in the survey that the use of Zip sum and Boron were increasing (Table 5).

Table 4
Number of farmers cultivated vegetable by types and by regions.

Region	Types of respondents	Number of respondents cultivate vegetables													
		Tomato	Reddish	Bean	Bottle gourd	Long yard bean	Bitter gourd	Cucumber	Snake gourd	Chili	Teasle gourd	Pointed gourd	Ridge gourd	Sponge gourd	Aram
Rangpur	Experimental	4	5	15	17	8	8	11	6	7	4	5	6	5	6
	Control	3	3	8	9	4	5	5	2	5	2	2	4	1	2
Cumilla	Experimental	18	3	16	16	2	2	8	2	9	3	1	5	2	4
	Control	8	2	9	7	2	2	5	1	3	2	1	2	1	2
Khulna	Experimental	13	11	14	13	6	10	8	3	14	7	5	5	3	6
	Control	6	4	8	6	3	6	6	2	6	2	3	3	2	5
All	Experimental	35	19	45	46	16	20	27	11	30	14	11	16	10	16
	Control	17	9	25	22	9	13	16	5	14	6	6	9	4	9

Table 5
Types of chemical and organic fertilizers used by the respondents.

Name of fertilizer	Use in rice (%)		Use in other crops (except vegetable) (%)		Use in vegetable (%)	
	Experimental	Control	Experimental	Control	Experimental	Control
Urea	100.0	100.0	100.0	100.0	100.0	100.0
TSP	100.0	100.0	100.0	100.0	100.0	100.0
MP	100.0	93.3	60.0	40.0	43.3	50.0
Zip sum	53.3	40.0	45.0	40.0	25.0	26.7
Boron	26.7	23.3	20.0	30.0	26.7	23.3
Cow dung	100.0	86.7	73.3	83.3	58.3	100.0
Compost	36.7	13.3	26.7	16.7	41.7	40.0
Vermi-compost	30.0	0.0	16.7	0.0	86.7	0.0

There is another concern in Bangladesh regarding the presence of organic matters in the soil. According to the soil survey of the SRDI, the organic matter content in the Bangladesh soil is about 1%. It needs to increase to improve the soil health. In this context, the DAE, is promoting organic fertilizer. The advance farmers are espousing this advice and are trying to improve their soil condition by using organic fertilizer. In this fact, vermi-compost has arrived as one of the best candidate to choice as organic fertilizer by the farmers. The survey stated that about 87% respondents of the experimental group are now applying vermi-compost in their vegetable plots, 30% in rice fields and 17% in other crops.

The range of use of vermi-compost is diverse and the dose is also varied from crop to crop and region to region. In an average, they applied more than 2 kg per decimal in rice fields and >1.5 kg per decimal in vegetable fields. According to the users, they applied at the highest dose of 3.9 kg per decimal in potato fields. The respondents have noticed that they are also introduced vermi-compost in jute and were getting better results.

Table 6
Dose of vermi-compost practiced by farmers for different crops.

Name of the crops	Kg/ Dec	Name of the crops	Kg/ Dec
Rice	2.20	Bottle guard	1.78
Wheat	0.00	Long yard bean	1.44
Maize	2.80	Korola	1.79
Sugarcane	2.00	Cucumber	1.73
Potato	3.89	Chichinga	1.56
Jute	0.75	Chili	1.57
Banana	2.00	Kakrol	1.60
Mustard	1.64	Potol	1.93
Tomato	1.30	Jhinga	1.64
Radish	2.00	Dhundol	1.67
Bean	1.47	Aram	1.50

Perception of the respondents about the vermi-compost

Since earthworm is considered as "Natural plough" from historical age. Now a day, people are concerned about the organic and safe food. In this regard, organic fertilizers are getting more popularity and acceptance. This was also reflected in this survey. About 100% of the respondents of both experimental and control group stated that vermi-compost is organic, natural and environmentally friendly. Again, about 87% among the experimental and 60% of the control group mentioned that vermi-compost help to increase soil fertility and grow resistance of the plants against pests. They believe that vermi-compost add organic maters in the soil and keep soil fertile for long period.

The role of vermi-compost, according to 63% of the respondents of experimental group and 40% of control group, it re-establishes soil and plant health (Anonymous, 2001; Al-Dahmani, 2003). About 62% respondent of experimental group and 27% of control group cited that vermin-compost could increase water holding capacity of soil by 30% or above (Munnoli and Bhosle, 2011). According to the opinion of the 57% respondents of experimental group, vermin-compost helps to de-toxify soils (Turgay et al., 2014). About 40% of the respondents of control group gave the similar opinion. About 48% respondents of experimental group stated that vermi-compost increase resistance to disease attack in the plants (Singh, 1993 & Suhane, 2007), it also increase number of flowers. In case of control group respondents, about 33% of them gave the same statement. A complex question was asked to the respondents about the role of earthworm and vermi-compost on greenhouse gas emission and about 10% from each group replied affirmatively. The respondents of experimental group were more inclined about the positive impact of vermi-compost on crop fields. It could be because of their good experience of using vermi-composts.

CONCLUSION

Considering the scarcity of land and the continued growth of population, there is no alternative but to continue intensifying agricultural production in Bangladesh. Organic farming has the potential to expand in Bangladesh by identifying the suitable niches in different locations. Research and development activities need to strengthen along with promotion of domestic and export marketing of high value organic agro-commodities. Government should take effective initiative through institutional approach to introduce organic farming in Bangladesh.

REFERENCES

Anonymous (2001). Vermi-compost as Insect Repellent; Biocycle, Jan. 01: 19.

Arancon, Norman (2004). An Interview with Dr. Norman Arancon; In Casting Call, 9 (2):42-48

Arancon NQ, Edwards CA, Bierman P, Welch C and Metzger JD (2004). Influences of vermi-composts

on field strawberries-1: Effects on growth and yields; Bioresource Technology, 93: 145-153.

Atiyeh RM, Subler S, Edwards CA, Bachman G, Metzger JD and Shuster W (2000b). Effects of Vermi-composts and Composts on Plant Growth in Horticultural Container Media and Soil; In Pedobiologia, 44: 579-590.

Brown GG (1995). How do earthworms affect microfloral and faunal community diversity? Journal of Plant and Soil, 170: 209-231.

Chaoui HI, Zibilske LM and Ohno T (2003). Effects of earthworms casts and compost on soil microbial activity and plant nutrient availability. Soil Biology and Biochemistry, 35 (2): 295-302.

Edwards CA, Domínguez J and Arancon NQ (2004). The influence of vermi-composts on plant growth and pest incidence. In Shakir, S.H. and W.Z.A. Mikhail (Eds.). Soil Zoology for Sustainable Development in the 21st Century, Self-Publisher; Cairo, Egypt, pp: 397-420.

Munnoli PM and Bhosle S (2011). Water-holding capacity of earthworms' vermicompost made of sugar industry waste (press mud) in mono- and polyculture vermireactors. Environmentalist, 31: 394–400

Nair, Jaya, Mathew K and Goen H (2007). Earthworms and composting worms-Basics towards composting applications. Paper at 'Water for All Life-A Decentralised Infrastructure for a Sustainable future'; March 12-14, 2007, Marriott Waterfront Hotel, Baltimore, USA.

Neilson RL (1951). Earthworms and Soil Fertility; In Proc. Of 13th Conf. Of Grassland Assoc., New Plymouth, US, 158-167.

Neilson RL (1965). Presence of Plant Growth Substances in Earthworms, Demonstrated by the Paper Chromatography and Went Pea Test, Nature, (Lond.), 208: 1113-1114.

Parle JN (1963). A microbiological study of earthworm casts. Journal of General Microbiology, 31: 13-23.

Pramanik P, Ghosh GK, Ghosal PK and Banik P (2007). Changes in organic-C, N, P and K and enzyme activities in vermi-compost of biodegradable organic wastes under liming and microbial inoculants. Journal of Bioresource Technology, 98: 2485-2494.

Scheu S (1987). Microbial Activity and Nutrient Dynamics in Earthworms Casts. Journal of Biological Fertility Soils, 5: 230-234.

Singh RD (1993). Harnessing the Earthworms for Sustainable Agriculture. Institute of National Organic Agriculture, Pune, India, 1-16.

Sinha, Rajiv K, Sunil H, Suhane RK, Singh PK, Chauhan K and Valani D (2009). Embarking on a Second Green Revolution for Sustainable Agriculture by Earthworms and Vermicompost: The Miracle Plant Growth Promoters and Protectors; The Environmentalist, U.K. (Communicated).

Suhane RK (2007). Vermicompost (In Hindi); Pub. Of Rajendra Agriculture University, Pusa, Bihar, 88pp.

Teotia SP,. Duley FL and McCalla TM (1950). Effect of stubble mulching on number and activity of earthworms. Agricultural Experiment Research Station Bulletin, University of Nebraska College of Agriculture, Lincoln, N.E., 165pp.

Tiwari SC, Tiwari BK and Mishra RR (1989). Microbial populations, enzyme activities and nitrogenphosphorus-potassium enrichment in earthworm casts and in surrounding soil of a pineapple plantation. Journal of Biology and Fertility of Soils, 8: 178-182.

Tomati V, Grappelli A and Galli E (1983). Fertility Factors in Earthworm Humus. In Proc. of International Symposium on 'Agriculture and Environment: Prospects in Earthworm Farming; Rome, 49-56.

Tomati V, Grappelli A and Galli E (1987). The Presence of Growth Regulators in Earthworm-Worked Wastes. In Proceeding of International Symposium on Earthworms, Italy, 31 March-5 April, 1985, 423-436.

Tomati V, Grappelli A and Galli E (1988). The Hormone like Effect of Earthworm Casts on Plant Growth. Biology and Fertility of Soils, 5: 288-294.

Turgay OC, Kizilkaya R, Karaca A and Cetin SC (2014). Detoxification of Heavy Metals Using Earthworms.Soil Biology, Chapter 21. DOI 10.1007/978-3-642-21408-0_21.