

## LIVESTOCK MANURE MANAGEMENT IN AGROECOSYSTEMS OF SOUTHWESTERN SIBERIA, RUSSIA

## WIRTSCHAFTSDÜNGERMANAGEMENT IN AGRARÖKOSYSTEMEN IN SÜDWEST-SIBIRIEN, RUSSLAND

MARIA STÖRRLE, HANS-JÖRG BRAUCKMANN & GABRIELE BROLL

### SUMMARY

In this study in the southwestern Siberian Tiumen oblast<sup>1</sup> the regional production of manure from livestock farming and its potential for nutrient recycling as well as its impact on the environment were assessed. In Tiumen oblast, peasant farms and mega farms dominate in livestock farming. A calculative method was applied to determine the amounts of manure, nutrient contents and the fertilization potential of manure for three main livestock production systems at local and regional scale. At peasant farms and small farms the nutrients from manure are being recycled through grazing on pastures and manure application on own arable fields. At mega farms manure is oversupplied on fields in the close proximity of the confinement buildings, is stored in open slurry lagoons or is disposed in the landscape. This handling leads to several environmental and agricultural risks. The main part of arable land belongs to mega farms, but only 2 % of arable land in mega farms is fertilized with manure. According to the calculated fertilization potential 23 % of arable land in mega farms could be fertilized with manure.

**Keywords:** southwestern Siberia, manure management, organic fertilization, livestock, regional nutrient production

### ZUSAMMENFASSUNG

Die Agrarlandschaft der Oblast Tiumen in Südwest-Sibirien ist geprägt durch eine heterogene Landnutzung. Extensive Landnutzung durch Kleinbauern einerseits und Großbetriebe mit großen Viehzahlen andererseits beeinflussen die Agrarökosysteme auf unterschiedliche Weise. In dieser Studie wurde der Nährstoffanfall aus dem Wirtschaftsdünger unterschiedlicher Produktionsformen sowie das Düngepotential auf regionaler und loka-

---

<sup>1</sup> *Oblast is an administrative division and is analogous to state or province.*

ler Ebene berechnet. Des Weiteren wurde der Einfluss der unsachgemäßen Handhabung des Wirtschaftsdüngers auf die Umwelt untersucht. Die punktuelle Ansammlung von Gülle oder Festmist in Großbetrieben führt zu erheblichen Umweltbelastungen. Die vorliegende Auswertung ergab, dass ein regionaler Nährstoffüberschuss bei Großbetrieben nur im Tiumenskii Distrikt besteht. Eine effiziente regionale Nährstoffverteilung findet in keinem Distrikt statt. Von den derzeit 2 % mit Wirtschaftsdünger gedüngten Ackerflächen bei den Großbetrieben könnten laut Düngepotential 23 % der Ackerflächen gedüngt werden.

**Schlüsselworte:** Südwest-Sibirien, Wirtschaftsdüngermanagement, organische Düngung, Viehhaltung, regionale Nährstoffproduktion

## 1 INTRODUCTION

Disintegration of the USSR has been followed by a strong decrease of agricultural production in Russia (Prishchepov et al. 2013). The number of cattle decreased by 65 % from 57 million in 1990 to 20 million in 2012 (Schierhorn et al. 2014). After 1990, on arable fields negative nutrient balances due to reduced or missing fertilization have risen. Maximum humus losses ( $0,8\text{--}1\text{ ton ha}^{-1}$ ) are observed in republics, krais and oblasts located in the steppe zone (Kosolapov et al. 2010). A similar trend was observed in Tiumen oblast as well. Cattle and pig stocks decreased after 1990 until 2011 by 75 % and 60 %, respectively.

There is a trend to increase agricultural production in Russia during the last years (Rosstat 2013). Nutrient demand for crop production and manure production will increase too. Manure handling and fertilization will be important factors for sustainability of agricultural production in the future (Burton and Turner 2003; Manna et al. 2005; Wortmann and Shapiro 2008; Materechera 2010; Kimura et al. 2011). High manure amount from intensive livestock production requires responsible handling, as inadequate manure handling causes environmental impacts like over-fertilization and water pollution (Otabbong et al. 2007). Over-fertilization leads to many agricultural and environmental problems, e.g. greater vulnerability of crops to diseases, delayed grain maturation, groundwater pollution due to nitrate leaching and high GHG emissions from manure (Zebarth et al. 1998; Dooody et al. 2012; Hutchings et al. 2014). Moreover, knowledge of the manure qualities and quantities is necessary for sustainable agricultural production (Materechera 2010). Thus, aim of this study is to investigate the potential of nutrient recycling on local and regional scale in Tiumen oblast, Western Siberia, Russia to support sustainability in livestock and arable farming.

In Tiumen oblast livestock (Fig.1) production systems differ widely in farm sizes as well as in the farming practices. Mega farms and smaller farms produce agricultural goods for