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Impasses in Transformation of the Food System

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Table of Contents

ISSN-Internet 2197-411x OLCL 862804632

Reviews

Front Cover page - Photo Credits

- The Naked Ape - Feeding Hunger from *https://flic.kr/p/s9PWhW*

Back Cover page - Photo Credits

- Marco Verch - Vegetable basket) from *https://flic.kr/p/V1gYQo*
- Kosala Bandara - Pulling in a fishing net from *https://flic.kr/p/a7uPVk*
- Brian Evans -mobile barbeque - Silay City, Philippines. from *https://flic.kr/p/22zeHMg*
- IFPRI -IMAGES - Woman carrying rice plants in China from *https://flic.kr/p/jAYhiW*

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UniKassel & VDW, Germany- December 2018

Editorial

Impasses in transformation of the food system

Dr. Walter Belik is a Full Professor of Economics at University of Campinas, Brazil, where over the span of six years he was the Coordinator of the Center for Food Studies. Also he was member of the National Council of Food and Nutrition Security and developed and coordinated the "Latin America and the Caribbean without Hunger" Initiative. He is a member of the Editorial Board of the Future of Food: Journal on Food, Agriculture and Society.

Last year, the UN statistics division released its new estimate for the world population reaching 9.8 billion in 2050. Earlier forecasts predicted that world population would reach its peak of 9.3 billion in 2050 with a slow growth or even decline thereafter. However, the new figures still allow a certain growth – above the replacement rate and until a date closer to 2100. This global revaluation is due to the persistent growth of the birth rate in countries in Africa and in the East.

These population's scenario of 2050 is beyond the the short time of SDGs - Sustainable Development Goals, which are expected to be reached by 2030, but still very near in time to impose some planning on World Food System issues. This issue is increasingly present in the specialized media, which have been treating the issue with some panic and alarmism, especially after the rise in food prices at the end of the last decade. The arguments are sparsely presented, but on the whole, they offer a "Malthusian" revisiting.

The main catastrophist ideas start from the distress of establishing a future expansion of food production beyond population growth. These authors show that yield increases in the main crops, namely rice, maize and wheat (the food base of mankind), are almost stagnant. Furthermore, hardly any new leaps can occur in the future from the current stock of technologies established by the Green Revolution from the 1950s. Adding to this are variables linked to demand, such as the allocation of current agricultural areas to produce energy biomass, changes in the diet of developing countries towards the greater consumption of meat, with consequent greater use of fertile land and, not least, the need to cut the contingent of undernourished people that now number approximately 800 million individuals.

In short, new solutions will have to be put into practice quickly considering that the climate change picture, with a higher frequency of crop frustrations, is already making itself present. Food-producing countries see this imbalance between supply and demand as a great marketing opportunity. At the same time that the FAO (Food and Agriculture Organization of the United Nations) announced the need to increase agricultural production by 60%, political leaders of producing countries, such as Brazil, promised an increase in supply of 100% by 2050.
In the past, theorists of the caliber of Josué De Castro and Amartya Sen had already disqualified the arguments for this imbalance. In analyzing the case of chronic famines of the 19th and 20th centuries, the Brazilian demonstrated that overpopulation was not the cause of undernutrition in several parts of the world. On the contrary, food insecurity was the main element that led to

ISSN-Internet 2197-411x OLCL 862804632

population increases, predominantly rural, considering that more workforce was needed to increase production (Castro, 1946). Amartya Sen, in turn, drew attention to the fact that in history, the many cases of food deprivation of certain populations occurred, contradictorily, in periods of plenty. The Nobel laureate in Economics in 1998, Amartya Sen, had been humiliated by the Director-General of FAO after the launch of his book "Poverty and Famines: An Essay on Entitlement and Deprivation" in 1981 stating that the "... book was absolutely the worst book on food and famine that he had ever read" (Sen, 2013: 2). The eminent Indian later warned the international community that the FAO was negligent about the problems of adequacy of food production because of the "persistent attempt to see hunger through the lens of agricultural production" (Sen, 1997: 9).

It is interesting to realize that the Hot Springs Conference of 1943 – which gave rise to the FAO in anticipation of the end of World War II – concluded that in a growing world there should be greater regulation in agricultural markets avoiding the problem of food scarcity (Timmer, 2010). For example, it was recommended that there be a Central Bank of Foods (The World Food Board) proposal controlling the world stocks with reserves for the fight against malnutrition (Friedmann, 1982). Coincidently, the surplus of American grains had been accumulating since the late nineteenth century, becoming permanent at that time and setting a period of falling international prices. In any case, there was no agreement among the countries. Therefore, this proposal did not go forward, leaving a mismatch between the demands of nutrition and agricultural production.

Any discussion on the future of the food system must go through a critique of the elements that normally link the dynamics of food markets with the dynamics of agricultural production. The determinants of the market and the production of food are distinct, and the understanding of their contradictions allows us to move towards the transformation of the Food System as a whole. However, in the narrative of large corporations, the controversial themes in the spheres of production and consumption are reworked and returned vestured by a new exteriority, seemingly without conflicts or need of regulation. For example, consumer concerns regarding sustainability, ethics, and decent work, among others, are requalified from the use of stamps, certificates and actions of Corporate Social Responsibility. This allows the agricultural production to adapt to the new times without risks that imply in a change of productive paradigm. These adaptations are part of a regulatory system with public-private features that allow corporations to capture certain quasi-rents derived from the bio-economy (Marsden and Fariolli, 2015). Sustainable transgenic soybeans (which require only small, selective amounts of agrochemicals), organic beef (which feeds on natural pastures), and agriculture with regularized labor (contracted through temporary labor cooperatives with no rights) are some examples of how it is possible to turn certain situations “green"and away from the real situation of agriculture, industry, and "dirty" exports.

For a more complete analysis of the characteristics of the Food System, we will take three constituent elements that can account for an updated approach to the present production regime, namely: the food supply chain, the food environments (physical context and culture), and consumer behavior (HLPE 2017).

Supply chain

Fordist era, the transformation of the food system, still involves some paradoxes that refer us to the rustic world of the local producer. It is curious to note that two of those paradoxes called our attention, and thus I want to emphasize them here:

1) The role of technology: In the so-called variety regime (Coriat, 1997), with its differentiated markets, the act of processing the food leads to a decrease in its added value. Contrary to being common, "more natural" products require more technology. Large investments in technology are being developed to make the most natural products with more texture, aroma etc. In addition, the distance and durability pattern (Friedmann, 1994) demands larger investments in distribution – attracting companies from the logistics and commercialization sector. The physical distance is to a decreasing degree a barrier to commercialization, although there is a growing rift between the field and fork. The technology allows us to call it a "fresh" product, even though it has been produced hundreds of miles from its production site.

2) No matter how the food system is globalized, its spaces and places act to reconfigure this system (Marsden, 2014: 20). The post-Fordist system of food production is placed in a decentralized and flexible way, incorporating the peculiar characteristics of each given geographic space (Jha & Chakraborty, 2014).

Food Environments

According to the latest FAO SOFI, malnutrition has been rising. Despite the struggle and commitment to achieving the Sustainable Development Goals, indicators have been increasing in the last two years, reaching 10.9% of the world population, or 821 million individuals. Extreme

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climatic events brought about by climate change have led to increases in food prices, but more than that there is a promiscuity between commodity prices and the use of these as derivatives in hedge contracts.

The financialization of commodities became evident during the subprime crisis of 2008. In that year, 40% of the transactions in the international markets of commodities were of the non-commercial type. In particular for the case of foods, the participations varied by 30% for the case of sugar and 45% for soybeans. In the international market, commodity-backed securities in general represented US $13 billion in 2003, reaching US $393 billion in 2011 (US $92 billion for food), and a record US$ 451 billion in April of that year (Belik & Correa, 2013).

Throughout the 20th century, real food prices were falling, even considering the spiral of the early 1970s. To a large extent this was achieved with the generalization of pre-sale contracts between sellers and buyers. The introduction of derivatives based on 1991 agricultural commodity price indices on the New York Stock Exchange disrupted this trajectory and changed the dynamics of futures market. The speculation based in commodities was aggravated when years later – in 1999 and seduced by the exuberance of the markets – the US government reduced public regulations further distancing the operation of physical market from the real commodity supply needs. The bubble burst of technology companies in 2000 further increased the influx of "investors" in search of bonds backed by assets considered solid, such as agricultural commodities.

Volatility and price increases have different and complementary causes, whether in the short, medium, or long term. Climatic shocks can cause price increases from the perspective of future scarcity but the volatility of these prices, in turn, has nothing to do with the natural cycle of agriculture. However, with its financial use and the low elasticity of demand, some refer to a crisis of underconsumption in food. In the medium and long-term, without any productive motive, volatility pushes prices upwards which starts a new upward cycle.

Why does the system not balance?

Because consumption is becoming less sensitive to agricultural prices that occur in the short-term. For the rich, the elasticity is zero, while for the poor it is decreasing. Terry Marsden (2014) points out that there would already be a market saturation in the more developed countries, resulting in a steady decline in the value of the primary sector, despite the increasing expenditure of the consumer with food. In short, food demand would be inflexible downward and current high prices would not have a significant impact on the primary sector.

Unless we are looking at the elite and the high-income markets, these movements place us further from a shift in the Food System toward reconnection with local circuits, reindependentization of agriculture, or what Ploeg (2010) calls recapture – introducing a new relationship between territory and food (Bowen, 2010). On the contrary, it is considered the current Corporate Food regime, in particular this new phase of neoliberal globalization, and as a deepening of the appropriation of nature (Dorr, 2018). Secondly, "There is growing recognition that the global food system does not aim to provide high-quality nutritional diets, social inclusion, decent working conditions, and environmental sustainability" (Dorr, 2018: 18).

Consumer behavior

The discussion on sustainability goes on through the discussion of consumption regarding the "metabolic rift", which is defined as the separation between people and nature (McMichael, 1999), and its disruptive tendency. In this, commercialization is the bottleneck for small and large agricultural producers. Furthermore, its recovery would reconnect the spheres of production and consumption – a challenging task for the retail networks and trading companies. Alliances between producers and consumers, the paradigm of agroecology, the so-called reflexive governance, and movements for food sovereignty, lead us to this new environment, but there are pitfalls along the way. The challenge is not to fall into the trap location where the "local is good, global is bad" (Marsden, 2014; Brunori et al, 2016).

Meanwhile, our reality shows that the expected reconnection movements are only marginal. There is no clear trend towards reconfiguration of the agrifood system. The presence of a new regime based on variety is growing but it is not the end of mass production, although there is an increasing relevance of aspects related to product quality. According to Coriat (1997), it is a regime of variety as a post-Fordist variant. In this case, "quality conventions" are of great importance, yet there is no legislation established in global terms. Even the general guidelines of the Codex Alimentarius can be overcome in coping with the hygienist collusion (Delfosse & Letablier, 1995), which excludes producers.

I hope that with these examples we can enlighten the debate about the difficulties and the obstacles that are posed for the reconversion of the system to feed. The tasks are manifold: to give access to the still huge contingent of malnourished people, to guarantee food sov-

ereignty for everybody and diverse population groups, and to interrupt the processes of production and consumption that attack the environment. The great question is how to promote this transition in an environment in which political forces are increasingly disorganized. The current Volume 6 Issue 2 of the "Future of Food: Journal on Food, Agriculture and Society", on the theme of "Impasses in Transformation of the Food System " contains papers providing insight to these issues from various regional and global perspectives. Furthermore, this edition is enriched with expert views and book reviews that bring a critical outlook of the thematic issues.

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Lesson learnt from Smart Rice Actions in Indonesia

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Climate change, rice production, smart agriculture, adaptation, NDC

Abstract

Smart Rice (SR) actions are innovative farming practices derived from climate smart agriculture (CSA) concepts and are directed to comply with mitigation and adaptation strategies to climate change. This study provided information about the plausible implementation of SR actions in Indonesia based on literature reviews and stakeholders' consultation with key informants working on crop management and climate information. The SR actions recommendations are a set of farming practices applied to fulfill the needs of rice growth and development set in specific agro-ecosystem areas. These include utilization of climate information for crop planning, selection of superior varieties and seed quality management, proper land preparation and soil nutrition management, application of water saving and efficient technologies, and integrated pest management. Policies and regulations in Indonesia supported the implementation of SR actions with regards to the government commitment in addressing climate change and targeting self-sufficiency of rice production. However, there were some challenges for farmers in adopting the SR actions because of limitation in knowledge and capacity, and availability of guidelines and tools. Coordination among key stakeholders (i.e., government, extension workers, universities, supporting partners, and farmers) within the rice sector should be institutionalized to address the challenges and to support the adoption of SR actions nationally. The recommendations were to a) improve the knowledge and capacity of the extension workers and farmers, b) promote the use of appropriate farming technologies and tools, c) integrate crop insurance with the weather prediction, d) modify the rule of government subsidy, e) apply crop simulation models and tools for measuring GHG emissions based on the agro-climate zonation, f) develop climate change impact assessments for measuring the benefits of SR actions under future climate change projections, and g) develop guidelines of the SR actions to ease the adoption of the proposed SR actions.

Introduction

Global climate change is expected to have a negative impact on crop production, in particular those grown in the low latitude areas (Cline, 2007). Downing et al., (2017) states that higher average temperatures could trigger plant diseases, as well as increase water stress, which leads to a decrease in crop productivity. This exposure could lead to increasing crop failures, which eventually decrease farmers' income. Generally climate change, indicated by rising air temperatures, changing rainfall patterns, and increasing intensity of extreme climate, poses a serious challenge to farming activities. Climate change, affecting the pattern of planting time

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(Koide et al., 2013), may pose a challenge to increase the harvesting area (Lizumi et al., 2015; Duku et al., 2018). For example, the trend of a shortened rainy season and a higher intensity of rainfall is considered as a major obstacle in the efforts of increasing planting area for crop production in Indonesia (Perdinan et al., 2016).

As a country located in low latitude region, the impacts of climate change on crop production such as rice, the staple food of Indonesian people (Simatupang et al., 2004), may lead to serious challenges which threaten the countrys' food security (Motta et al., 2005; Sumaryanto, 2012). Climate change, which leads to shifts in climate variability and extremes, is estimated to significantly impact rice production in Indonesia (Hosang et al., 2012) . Higher temperature in combination with decreasing rainfall were estimated to decrease rice production in Indonesia from about 20% to 38% (Syukyat, 2011; Hosang et al., 2012; BMKG et al., 2013). Another challenge is the potential impact of climate change on increasing the frequency of climate extreme events, such as floods and droughts, that negatively impact rice production (Surmaini et al. 2011). Based on data and information from the Directorate of Plant Protection of the Ministry of Agriculture (2013), flood in 2010 and drought in 2011 resulted in a decrease of paddy production and could even lead to crop failure for the paddy production centers in Java (Perdinan et al., 2016).

Furthermore, the impacts of climate change on humid tropic areas such as Indonesia may create favorable conditions for pest and disease infestations. As an example, higher temperatures in combination with higher humidity supports the growth and development of the rice pest known as brown planthopper (BPH), named in bahasa "Wereng Batang Cokelat", which negatively impacts rice production. The BPH damages rice plants, through an extensive sucking of the cell sap. The pest also transmits viruses so that increased levels of BPH infestations occasionally are accompanied by substantial losses in rice production (Mejaya, 2014).

By understanding the impacts of climate change, this paper evaluates innovations and actions to address the negative impacts of climate change for rice production in Indonesia. The evaluation is based on literature review and consultations to key informants in the country. The explored actions are directed to support the "Climate Smart Actions" for supporting of self-sufficient rice production in Indonesia. Hereafter the "Climate Smart Actions" is named "Smart Rice" (SR). Principally, the SR actions are all actions that are part of Climate Smart Agriculture (CSA) strategies, which are directed at applied farming technologies and practices to fulfill the needs of rice growth and development in specific agro-ecosystem areas. The SR actions should provide benefits to improve yield or income, reduce greenhouse gases emissions, enhance efficiency of production inputs, and achieve resilience (Rioux et al., 2016).

The principles of SR actions are well suited with government targets for commitment in addressing climate change as articulated in the document of the National Determined Contribution (NDC) of Indonesia (Government of Indonesia, 2016) submitted to UNFCCC in 2016. The NDC prioritizes agriculture as one of the key development sectors in which rice production plays a major role in agricultural development, understanding rice production contributed to and affected by climate change. The adoption of the SR actions at a large scale or nationwide is also expected to contribute positively to support the self-sufficiency target of rice production in Indonesia (Sumaryanto, 2012). Thus, this paper reviews the initiatives on SR actions in Indonesia, particularly the potential benefits, the challenges, and the national supports for the implementation of SR actions, which can provide insight to define way forward strategies.

Overview of Climate Smart Agriculture

Climate Smart Agriculture (CSA) is a regional framework initiated by the Food and Agriculture Organization (FAO) as an effort in facing climate change. CSA has several principles, namely: (1) consideration of national development priorities and local context; (2) coordination across agricultural sectors (crop, livestock, forestry and fisheries) and with energy and water development sectors; (3) working across multiple levels and scales from farm to landscape, local to global, short and long term; and (4) promotion of synergies and multiple objectives and outcomes, which are context specific. Generally, direction of CSA is defining actions on climate change mitigation and adaptation to enhance the achievement of food security. Shirsath et al. (2017) suggests that the promotion of CSA requires an understanding of sustainability, both the costs and benefits, and the environmental impacts of various technological interventions in the local context on current and future climatic conditions.
The focus on this paper is on smart rice (SR) options, which is derived from the notion of CSA strategies (i.e., the adaptation and mitigation actions) for the rice sector. It is explored based on literature reviews and stakeholders' consultations. The reviews listed a number of actions directed to enhance rice production, such as the use of low-emission rice varieties, the use of ZA fertilizer to replace N fertilizer, application of no-tillage cultivation – "tanpa olah tanah" and intermittent (wetting and drying-WD) irrigation technology (Surmaini et al., 2011; Lamid, 2011). The planter method of "tanpa olah tanah" is a way of planting without treatment on land prepara-

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tion. For example, for ground reversing and extinguishing, only a hole is needed to immerse the seeds into the soil (usually using planter tools).

Liu et al., (2013) proposed adaptation options such as rice variety tolerance to high temperature, improved farming management, balanced soil fertility, and adjusted planting and harvesting time to changes in temperature and sunshine in order to increase yields and maintain high grain production. A review conducted by Perdinan et al. (2016) for rice production in Indonesia lists a numbers of climate change adaptation options that include climate field school called in Bahasa "Sekolah Lapang Iklim" (SLI), climate insurance, improvement of farming techniques, simulation technologies, resistant-superior varieties, planting calendar, prediction of harvesting time, and irrigation technologies.

Method

This study evaluated the initiatives on SR actions based on literature review and the stakeholders' consultation. The review was directed to explore advances on rice production strategies based on available data and information (i.e., articles, reports, etc.) in the country. The consultation was conducted through personal communication or interview key informants of the government officers working on rice production and climate actions, i.e. Ministry of Agriculture - MoA (Directorate Serealia, Directorate General of Food Crop; Research and Development; and Agricultural Services), Meteorological, Climatological, and Geophysical Agency-BMKG, Extension Workers, private sector and farmers). The interviewed stakeholders are listed in Table 1.

Literature Review

Literature review focused on climate change impacts on rice production and explored adaptation practices/technologies to address the impacts of climate change. We also reviewed specific information in the country related to 1) the existing regulations on rice sector to support farmers in addressing the negative impacts of climate change, 2) the technical guidelines related to rice sector (subsidy and farming practices), and 3) research papers/journals with the key words of climate change, adaptation, mitigation, climate smart agriculture, and rice production.

The Stakeholders Concultation

The stakeholders' consultation was conducted through personal interviews either in-person meetings or phone calls. The interviews employed a set of questionnaires focused on identifying CSA options and their implementation in the country. Specifically, the personal interviews were designed to explore information on the impact of climate change on rice production, current practices or technologies considered as SR actions, and challenges in adopting the proposed SR practices/technologies. Hereafter, we cited collected information from the stakeholders' consultations indicated as "personal communication".

The results of desk-reviews and stakeholders' consultations were then employed to formulate way forward strategies to endorse and support the adoption of the SR actions.

Findings and Discussion

The Government Supports

The government of Indonesia (GoI) essentially supports the implementation of the SR actions (i.e., CSA) nationwide through policies, programs and initiative actions. The regulations on rice sectors mandated to the Ministry of Agriculture (MoA) play a major role in promoting the implementation of the SR actions nationwide. The GoI mandated the MoA through regulations to support farming practices purposed to improve farmers' livelihoods. The regulations are required as a reference for devising programs that can be implemented in the country. There are numerous regulations associated with agriculture, in particular to support rice production in Indonesia, and this paper only explores those regulations that are related to support the implementation of CSA for sustaining rice production (i.e., the SR actions). The policies, programs, and actions explored are related to the proposed SR actions for improving the farming practices as listed in Table 2 and detailed in Table 3.

a. The Government Programs

The government provides financing supports for improving farming activities within the directorate of food crops (cereals production division). The allocation budget of the government subsidy for management activities of cereals production in 2017 was approximately Indonesian Rupiah (IDR) 3,747,436,486,000,-. The allocation for the rice sector was in the form of seeds, fertilizers, pesticides , agricultural tools and machinery, integrated pest management (IPM), organic fertilizer management unit (UPPO) and crop protection from the effects of climate change, which is named in Bahasa as "Penerapan Penanganan Dampak Perubahan Iklim" (PPDPI) (MoA, 2017).

Integrated Pest Management (IPM) in Indonesia has been regulated through Indonesian Government Regulation No. 6/1995 with respect to Plant Protection. The GoIs has introduced the IPM technology to control pests

Table 1: Consulted Key Stakeholders

Number	Name	Institution
1	Ari and Gatot	Directorate of Crop Protection, Ministry of Agriculture
2	Ali Jamil	Directorate of Cereals, Ministry of Agriculture
3	Suismono	Post Harvest Research and Development, Ministry of Agriculture
4	Woro Estiningtyas and Pramudia	Agricultural Research and Development, Ministry and Agriculture
5	Astrina Yulianti	Center for Assessment and Development of Agricultural Technology, Balai Besar Pengkajian dan Pengembangan Teknologi Pertanian (BBP2TP), Ministry of Agriculture
6	Ismail Wahab	Indonesian Center for Rice Research, Ministry of Agriculture
7	Darmadi	Center for Assessment of Agricultural Technology-Balai Pengkajian Teknologi Pertanian (BPTP), Jember
8	Utema	Unit of Food Crops and Holticulture, North Sumatra
9	Marjuki	Meteorological, Climatological, and Geophysical Agency
10	Purwono	Bogor Agricultural University
11	Mahesh Nimje	PT Olam Indonesia
12	Haryanto	PT Sang Hyang Sri
13	Novika Rukmi	Subang Regency Agriculture Office
14	Endang Rukayat	Subang Regency Agriculture Office
15	Tati Hartati	Trainer
16	Mastam	GAPOKTAN (Farmers group)
17	Cahyana (FIELD)	Implementing Partner-CSA-FAO
18	Ade and Cahyana	Deutsche Gesellschaft für Internationale Zusammenarbeit GmbH (GIZ)

Table 2: Consulted Key Stakeholders

Farming practices	**The approach**
Crop planning	Use the integrated cropping calendar tool (KATAM) and other assessment tools, such as LKP, to gain information for planning the cultivation activities.
Selection of rice varieties and seed quality management	Selection of rice variety should consider climate forecast and other agro-ecosystem condition, followed by proper seed treatment
Land preparation and planting	Strongly encourage proper land levelling while choosing tillage practices and planting techniques based on local conditions
Water management	Water saving technologies, not continues flooding
Soil nutrition management and pest control	Site specific fertilization, use assessment tools, such as paddy soil test kit (PUTS) and Leaf colour chart (LCC), to realize fertilization needs
Pest management	Integrated pest management (IPM) which focus on prevention rather than extermination

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Table 3: The policies, programs and initiatives on climate Smart Rice (SR) actions

Farming Practices	Policy	Program	Action
Crop planning	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015 UPSUS PAJALE General Guidelines through Irrigation Networks and Other Supporting Facilities • RI Minister of Agriculture Regulation no. 40 / Permentan / SR.230 / 07/2015 Facilitation of Crop Insurance	• KATAM Terpadu (2700 district/10 province)->75 mil/BPTP (80% farmers adopt KATAM) • Jajar Legowo Super (JARWO) • Climate Field School (SLI) IDR 200 million/SLI 3 • Crop insurance	• Integrated KATAM online monitoring system using CCTV • Integration of rice standing crop on integrated KATAM information system • Jajar Legowo raw-spacing • The insurance was subsidized about 80%/Ha • Flood and dorught season prediction
Selection of rice varieties and seed quality management	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015 UPSUS PAJALE General Guidelines through Irrigation Networks and Other Supporting Facilities • Minister of Agriculture Decree No. RI. 1397 / RC.110 / C / 2016 Technical Guidelines Distribution of Government Support Scope of Directorate General of Food Crops T.A 2017	• Seed Subsidy IDR 298.000.000.000 • Jajar Legowo Super (10000 Ha/10 Provinsi)	• Release more than 300 paddy variety (VUB), especially, superior varieties (VUB) (resistance of flood (Inpari 29 & 30), dorught (situ bagendit, Inpari 42, 43), salinity (Inpari 34 & 35) • Use low-emission variety
Land preparation and planting	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015	• Farming facilitation Subsidy (4,6 Billion) • JARWO Super	• Shed of biodecomposers on second tillage • Land management information system
Water management	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015	• PPDPI (Biopori and "Sumur Pantek" (IDR 389.825.000,-) • JARWO Super	• Intermitten irigation • Support to making "embung" • "Tetes" irigation • Pump assistance
Soil nutrition management and pest control	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015 • Minister of Agriculture of the Republic of Indonesia Regulation no. 69 / Permentan / SR.310 / 12/2016 Needs and Highest Retail Price (HET) of Subsidized Fertilizer for Agriculture Sector Budget Year 2017 • Regulation of the Minister of Agriculture Number 48 / Permentan / OT.140 / 10/2006 concerning Guidelines for Good and True Cultivation of Food Crops • Minister of Agriculture Decree No. RI. 1397 / RC.110 / C / 2016 General of Food Crops T.A 2017	• KATAM Terpadu • JARWO Super • Balance fertilizer, using soil test kit (PUTS) • Fertilizer subsidy In-organic: 7.654.000 Tons Organic : 895.288 Tons • UPPO (Organic Agriculture) (IDR 262.5 billion)	• Prediction of soil fertility • Site specific nutrient treatment (using software) • Organic fertilizer subsidy
Pest management	• Law no. 12 Year 1992 Plant Cultivation System • Minister of Agriculture Regulation no. 3 Year 2015 • Minister of Agriculture Decree No. RI. 1397 / RC.110 / C / 2016 Technical Guidelines Distribution of Government Support Scope of Directorate General of Food Crops T.A 2017 • RI Minister of Agriculture Regulation no. 40 / Permentan / SR.230 / 07/2015	• Integrated Pest Management (40-45 million/IPM): IDR 12.712.000.000 • Pesticide subsidy IDR 70 billion • Crop insurance	• Use of biological agents for pest control • Motion control example • Control of pest with organic pesticide • IDR 6 million compensation, if OPT> 75%

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that is inline with the CSA concept. Diratmaja (2015) described that the basic principle of IPM is to apply an-organic pesticide only if other controls cannot reduce pest populations. Others controls are parasites, predators, pest pathogens, and biological pesticides (Diratmaja, 2015).

The program initiated by the GoI that implemented the IPM and UPPO is the innovative farming practices on modifying row and spacing named "Jajar Legowo (JARWO) Super". Based on the technical guideline of JARWO Super (MoA, 2016), the JARWO Super promotes the application of balancing fertilizers (i.e., anorganic and organic fertilizers). The technique suggests that the application of urea fertilizer of about 200 kg/Ha and Phonska NPK 300 kg/Ha will potentially reach rice productivity levels of more than 10 tons dry grain/Ha. The Phonska is applied at about 100% at planting and urea is about 1/3 at 7-10 days after planting, 1/3 parts at the age of 25-30 days after planting, and 1/3 parts at the age of 40-45 days after planting. To improve soil fertility, farmers can apply manure that has been cooked perfectly at a dose of 2 ton/Ha or Petroganic organic fertilizer at a dose of 1 ton/Ha, which is distributed during the second tillage, in addition to the chemical fertilizers.

b. The Benefits of The Programs

The government initiatives on farming practices provide incentives for farmers, although no cash subsidy is distributed. For example, the rice row and spacing technology, also known as the JARWO Super program, recommends applying new rice varieties, such as Ciherang Sub-1 (the new variety of Ciherang), Inpari-32 HBD, and Inpari-33, whose potential yields are higher than the existing Ciherang varieties. The potential yields of the superior varieties are about 13.9 ton/Ha (Ciherang Sub-1), 14.4 ton/Ha (Inpari-32 HBD), and 12.4 ton/Ha (Inpari-33). Meanwhile, Ciherang varieties yield only about 7.0 ton/Ha. The net income of rice farming with the JARWO Super can reach IDR 42,487,222/Ha; whereas, the conventional technique is only about IDR 17,568,333/Ha, boosting profits of about 141.8% in average of all varieties (MoA, 2016).

The other program that is strongly linked to climate change response is modifying the Planting Calendar or in bahasa is named "Kalendar Tanaman" (KATAM). The interview with the key informant of KATAM producer (Annex 2) claimed that farmers applying the KATAM can alleviate the potential negative impacts of climate exposure up to 80% higher than those who do not apply KATAM. Another program focuses on capacity building activities on the use of climate information for rice production, also called Climate Field School or in bahasa is named "Sekolah Lapang Iklim" (SLI). This program was firstly introduced over a decade ago under coordination of the Directorate Plant Protection of the MoA to improve farmers' understanding on climate fluctuations and its impacts on rice productivity (Boer et al., 2004). Based on our communication with the organizer of SLI, which now is running by BMKG, the SLI program can increase rice yield up to 30%.

c. The Obstacles of The Programs

The government's initiatives to support farmers for improving farming practices to some extend have not been effective due to constraints in subsidy distribution and financing mechanisms. The main benefit of the subsidy is to reduce the burden of farming costs to farmers, However, funding for the government programs is not evenly distributed at the local level because of the budget limitation, lack of socialization or knowledge, and lack of available farming tools. These concerns limit the ability of agricultural services at the regional level to implement the national programs as explained by Utema when we conducted the personal interviews (Annex 2). Additionally, access to the resistant rice varieties to environment stress that is released by the government is still limited. Also, the private companies that sell seeds mostly do not sell the resistant varieties to environmental stress.

Furthermore, farmers may not continuously adopt the initiatives on SR actions after the program ends. This situation may happen due to lacking in supporting tools and infrastructures as well as institutionalization mechanism to support the programs at the local level. For example, the KATAM has been released, but this system is a one-way approach as farmers cannot interactively use the system to tailor properly the required farming practices for the specific climate fluctuations at the field levels. For the modification of proper farming practices, the Rice Agro Advisory Service or in bahasa named "Layanan Konsultasi Padi Indonesia" (LKP) should be combined with the KATAM. The LKP offers farmers more informative knowledge about farming practices than KATAM.

Unfortunately, a study conducted in three villages of Central Java located in the three districts (i.e., Banyumas, Purwokerto, Banjarnegara) explained that farmers and extension officers still rarely used both KATAM and LKP (GIZ, 2017b). Another study conducted in six villages in Pasuruan, East Java, revealed similar facts that KATAM was almost unknown to farmers, while the extension workers have limited knowledge on KATAM which may be due to long communication chain required for disseminating the updated information in the KATAM system (Anggarendra et al., 2016).

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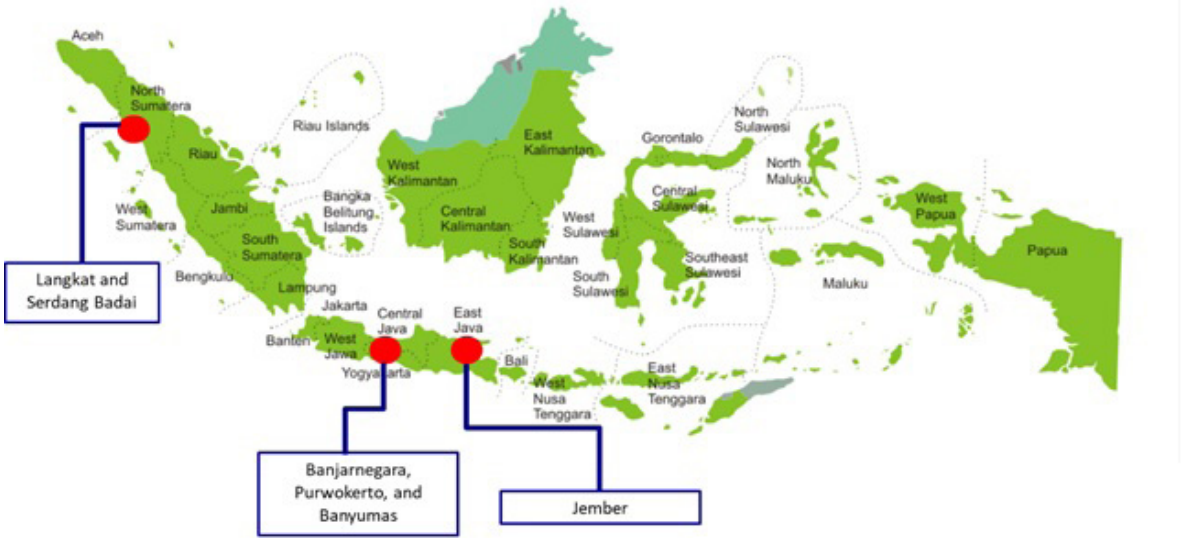

Figure 1: The map of GIZ project locations in Indonesia

Another example of the introduced program is crop insurance. This program is one of the government programs to support farmers to adapt with climate disasters (MoA Regulation No. 40 / Permentan / SR.230 / 07 / 2015 on Facilitation of Crop Insurance). In general, the main objective of this program is to increase farmers' resilience towards climate change. Crop insurance helps farmers in reducing risks to climate change impacts, increasing farmer's income, ensuring available costs for production inputs, as well as availability of working capital. The GoI through MoA supports the execution of crop insurance through a numbers of pilot projects, in cooperation with an insurance company named JASINDO. For the pilot studies, the insurance premium was subsidized about 80% so that farmers pay lower premium (BB Padi, 2015). Additionally, farmers must comply with the insurance requirements, such as paying premiums on time. However, it was found based on a case study in the North Sumatera and East Java that the capacitated staff of JASINDO, who should do the risk assessment, was not widely available (GIZ, 2017a). Understanding the challenges, stakeholders' involvement to build comprehensive and reliable information is important foundation to pass the challenges. The engagement of multi-stakeholders to accelerate farmers' adoption on recommended SR actions should also be proposed and institutionalized.

Stakeholders Analysis

Stakeholders' engagement is a critical aspect to endorse the adoption of SR actions, directed to achieve the goals of CSA i.e., increase yield, income, resilience, input production efficiency, and greenhouse gas reduction (GHG reduction), by farmers. The stakeholders referred in this paper are government (Ministry of Agriculture-MoA and Meteorological, Climatological, and Geophysical Agency-BMKG), extension workers, supporting partners, universities and farmers.

The government initiatives, such as the KATAM and the JARWO Super, are designed to be established countrywide. For example, the KATAM provides information on the planting calendar and recommended farming practices up to the sub-district level across the country. Meanwhile, the JARWO Super has been demonstrated in a number of locations (about 11 provinces in Indonesia; BB Padi, 2017)). Those initiatives are promising actions in response to climate change. However, the implementation of the options should be recommended for the right place and time with reference to farmers' capacity. In addition, the potential benefits of applying the options should also be clarified by understanding that the implementation will require capacity development and financial investments.

For this purpose, the Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ) initiated activities to promote the CSA in some Asian countries, including Indonesia (Figure 1). The projects of GIZ, named Green Economy and Locally-Appropriate Mitigation Actions in Indonesia (GE-LAMA-I) and the Better Rice Initiative Asia (BRIA) have piloted the potential use of CSA to farmers. The GE-LAMA-I is a project to implement the CSA conducted in Banjarnegara, Purbalingga and Banyumas (Figure 1). The actions undertaken in the GE-LAMA-I were (1) crop planning (utilization of crop calendar with updated climate information); (2) use of a high yield and climate resilient variety; (3) seed quality management before planting; (4) Jajar Legowo (row-spacing) technology; (5)

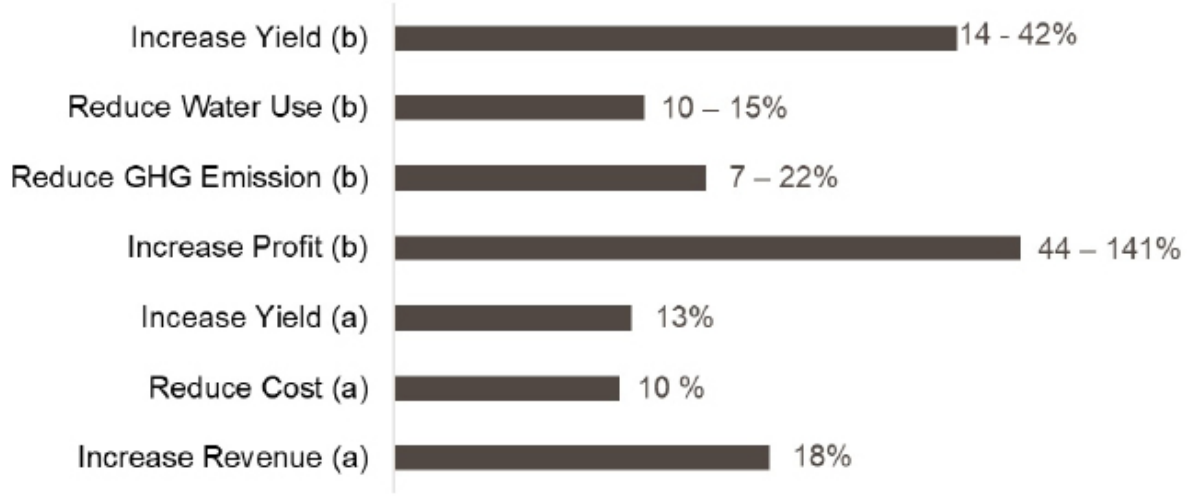

Figure 2: The estimation of benefits for applying the recommended options applied in the BRIA indicated by the letter of "a" and the GE LAMA-I study indicated by the letter "b" in comparison to conventional farming practices. Source: (GIZ, 2017a; GIZ, 2017b).

water saving technology (local assessment); (6) integrated pest management (IPM), such as using bio-pesticide, planting of pest barrier plants, reduced pesticide use, the use of natural enemies, and (7) site-specific nutrient management (PUTS). The benefits of the cultivation technologies applied in the GE-LAMA-I study are about 14-42% higher yields, 44-121% higher profits, 7-22% less greenhouse gas (GHG) emissions and 10 – 15% lower use of water (Figure 2).

As for the BRIA, the proposed options for the SR actions are likely to similar with those of GE-LAMA-I Project. The options are (1) seed treatment technology (use superior varieties, in Bahasa namely "Varietas Unggul Baru" (VUB); (2) row spacing technology like Jajar Legowo (use transplanter); (3) soil and nutrient management based on soil test kit, and (4) integrated pest management (IPM). GIZ introduced the BRIA project in North Sumatera and East Java. The BRIA study revealed promising results indicated by higher yields and revenue received by the farmers following the BRIA recommended options (hereafter named as BRIA-FARMERS) in comparison to the farmers which applied the conventional farming practices (hereafter named as NON-BRIA-FARMERS). The BRIA study conducted in North Sumatra and East Java supported the GE-LAMA-I study as the SR actions provided higher yields and lower production costs (Figure 2).

In addition, the role of key stakeholders also determines the success of adoption of SR actions at the farm level. The extension workers are one of the key elements understanding they are working closely with farmers. Therefore, equipped the extension workers with the knowledge and skills on SR actions should be promoted through training or workshops. The private sectors, which are responsible for producing and supplying production inputs, should also be actively engaged in accelerating the adoption of the SR actions. The private sectors can include information associated with the SR actions as a direction in using their products. They also can work with the farmers' group in order to consolidate the farming practices to be followed by farmers. Finally, the universities or research institutions can direct their research to handle issues faced by farmers. A collaborative communication should be established among the key stakeholders. The interviews conducted in this study also revealed that the cooperation between stakeholders is very important in order to promote new inventions (e.g. SR actions) to be adopted by farmers. The key stakeholders on rice sector in Indonesia and the proposed linkages or relation among the stakeholders in supporting the implementation of farming practices categorized as the SR actions is shown in Figure 3.

Way Forward Strategies

The Smart Rice actions are promoted to understand the potential benefits of the actions in order to increase yields, income, resilience, and to decrease production costs and GHG emissions. These benefits are compromised with the studies conducted by GIZ in North Sumatera and East Java. These identified benefits encourage the needs to up-scale the SR actions.

The promotion of up-scaling the SR actions can support the achievement of the NDC targets committed by the

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GoI that prioritize agriculture as the key development sector (GoI, 2016) and the self-sufficiency rice production target. The NDC is a part of the Indonesian commitment following the ratification of Paris Agreement through Law No.16/2016. The NDC is basically the national commitment to contribute in emission reduction as efforts to limit rising global temperature of less than 20C. The SR actions are also in line with the concept of Sustainable Rice Platform (SRP). Sustainable Rice Platform (SRP) have three approaches, i.e. (1) promote resource efficiency and sustainability in trade flows; (2) promote production and consumption operations; and (3) promote supply chains in the global rice sector (SRP, 2017).

Moreover, it is important to sustain rice production through actions that are environmentally friendly and able to adapt with the environmental stresses, such as higher temperature and erratic rainfall. Although SR actions have many benefits, the SR actions also have many challenges for their implementation at the farm level. The challenges pose difficulty to farmers in adopting the actions. This study reveals that the challenges are (1) the activities undertaken by farmers do not always follow the government recommendations, such as farmers difficult to adopt new-climate tolerance varieties; (2) the new technology is more difficult than the existing cultivation system; (3) farmers may not well be capacitated to use the tools subsidized by the government, such as farming facilitations, soil test kit "Perangkat Uji Tanah Sawah" (PUTS); (4) available funding is limited at the local level (i.e., district level); (5) specific diseases that harm for rice (Kerdil Hampa) is in searching for treatment; (6) homemade organic fertilizer does not meet the standard; (7) KATAM should be updated and contains prediction error, causing crop planning to be inaccurate; (8) lack of evaluation for recommended application of KATAM at the farm level; (9) uneven distribution of new superior varieties (VUB); and, (10) the supporting facilities are not well supplied to ease farmers access to climate change information. For example, available climate information cannot be accessed due to limited internet connection at the village or remote areas. We also found there is a lack of climate change information and technologies that is understood by farmers and extension officers.

With reference to the GIZ study (GIZ, 2017b), another issue is that farmers did not implement the Jajar Legowo. The reasons are 1) the additional labor costs are relatively expensive to farmers , 2) the system are not well-known by farmers, 3) the system requires more time, and 4) lack of guidance or supervision. About 90% of farmers in Jember, Langkat, and Serdang Badai, the targeted areas of GIZ study, did not do any seed treatment (GIZ, 2017a). The other challenge is the implementation of Integrated Pest Management (IPM) that requires farmers to use Personal Protection Equipment (PPE). It has been known that PPE are important to protect farmers from negative impacts of pesticide exposure. However, most of the farmers do not use any protection equipment while spraying pesticides.

Essentially, the challenges of adopting SR actions are associated with the needs for tools to properly assign suitable SR actions with respect to climate fluctuations affecting growing conditions at the field level. Chhetri et al. (2017) justified that the major challenges for scaling-up the CSA in a diverse agro-ecological zones are identification, prioritization, and promotion of available CSA technologies with regards to local climatic risk and required technology. Evaluation of the farmers' preference is also important to improve the farmers' adoption to the recommended practices or technologies. For example, Chhetri et al. (2017) found that the five farmers' preferred adaptation options in all rainfall zones, namely crop insurance, rainwater harvesting, fodder management, weather-based crop agro-advisory, contingent crop planning, laser land leveling, agroforestry, climate smart housing for livestock, and site specific integrated nutrient management (Chhetri et al., 2017).
Understanding the identified challenges, coordination and cooperation among key stakeholders is an important element to enhance the adoption of SR actions by farmers. The SR actions for Indonesia include: 1) selection of rice varieties and seed quality management, 2) soil nutrition management and pest control, 3) water management, 4) pest management, 5) land preparation and planting, and 6) crop planning.

The promotion to adopt the SR actions nationwide should be supported by the government policies, regulations, and programs. In this case, the MoA should create favorable and enabling conditions to capacitate farmers with adequate guidelines and tools that can be accessed and used by the farmers. The extension workers play a critical role as part of the government institution by working together with farmers through training and assistantship facilitation. The farmers' institution, such as farmers groups – named in bahasa "Gabungan Kelompok Tani" (GAPOKTAN) – should also be strengthened as a network to increase farmers' confidence in adopting new initiatives. The other stakeholders and their role or contribution to support the adoption of SR actions in Indonesia are clarified in Figure 3.

Recommendation

The implementation of SR actions face several challenges, especially when upscaling the SR actions. To address

these challenges, the following recommendations can be considered.

Modification of existing initiatives or programs

1. Improve the capacity of extension workers and farmers to use the Information and Communication Technology such as KATAM and LKP for crop-climate advisory.
2. Improve the use of KATAM with respects to farmers' needs, for example: the use of climate regionalization for KATAM. The mechanism of accessing updated information on KATAM and its interpretation at the farm level should directly involve extension workers and farmers' groups. Interactive communication technology should be advanced so that KATAM is not only a one-way direction, rather a collaborative work between extension workers and farmers. Thus, it should be endorsed to interpret the KATAM at specific farm fields.
3. Integrate crop insurance and/or weather-based insurance into climate field schools to support the adoption of new innovations on farming practices and technologies. The Climate Field Schools should be institutionalized and run by farmers' groups accompanied by the extension workers who has sufficient capacity on CSA.
4. Modify the rule of access or distribute irrigation to farm fields considering the SR actions supply water with respect to crop needs in order to enhance water use efficiency. The users should also be equipped with adequate knowledge regarding the techniques.
5. Develop tools to evaluate the adoption of SR actions and the benefits of the actions. The tools can be used to survey farmers' preferences to adopt the SR actions as well as the required facilitation to identify target locations and farmer' criteria to adopt the SR actions.
6. Encapsulate government programs on economic incentives, such as subsidies with the insurance scheme, and/or access to micro-finance, but do not subsidize the production inputs (i.e., fertilizers, seeds). The subsidy on insurance can offer benefits to boost the adoption of new invention that may be embedded in the terms and conditions of the insurance scheme.

Development of new initiatives or programs

1. Agro-Climate Zonation: provide spatial information on agro-climate zonation where suitable SR actions can be allocated. The application of crop simulation model applied to the agro-climate zonation can also be employed to provide information on the suitable areas for farming the new resistant varieties or the other farming practices, i.e., helping for tactical farming management.
2. Provide tools to measure GHG emissions and to properly allocate SR actions with reference to agro-climate zonation and climate change scenarios to improve the resilience of rice growing areas in the future. The estimation can clarify the contribution of rice sector to agriculture as one of the key sectors in the NDC, and eventually to the achievement of sustainable rice production.
3. Provide the baseline of climate change impact assessments for each specific agro-climate zone over the country so that estimation of the benefits of applying SR actions for future climate change can be evaluated.
4. Develop guidance on determining farming actions as climate change adaptation with respect to the regional climate change impact assessments and the contribution to resilience-pathway
5. Improve the role of farmers' groups (GAPOKTAN) on devising farming practices applied to a large area, for example by collated the cultivation areas owned by farmers (formation of rice farm management unit) to apply recommended SR actions to reach the efficiency in terms of economic of scale.

Conclusion

Farmers face challenges maintaining rice production exposed to climate change exposure. One of the strategies that can be applied to address the impacts of climate change on rice sector is by adopting "Climate Smart Actions" for rice production hereafter named "Smart Rice" (SR). Principally, the SR actions are directed to apply farming practices and management with regards to the needs of rice growth and development grown in an area with specific agro-ecosystem characteristics. This study suggested that the benefits of SR actions include increase yields; reduce greenhouse gas (GHG) emissions and rice production inputs; and, increase farmer's incomes and resilience.

Many initiatives have been introduced and released by the Government of Indonesia (GoI) to boost rice production, which are also relevant to support the adoption of SR actions. The SR actions include: 1) selection of rice varieties and seed quality management, 2) soil nutrition management and pest control, 3) water management, 4) pest management, 5) land preparation and planting, and 6) crop planning.

However, the adoption of SR actions faces many challenges due to mainly lacking of knowledge, capacity,

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guidelines, and tools. To address these challenges, a number of strategies are grouped into two broad and recommended categories, namely: 1. Modification of existing initiatives or programs and 2. Development of new initiatives or programs. These recommendations focus on designing actions directed to a) improving the knowledge and capacity of the extension workers and farmers; b) promoting the use of appropriate farming technologies and tools (e.g. KATAM) with respects to farmers' needs; c) integrating crop insurance with the weather prediction; d) modify the rule of government subsidy; e) applying crop simulation models and tools for measuring GHG emissions based on the agro-climate zonation; f) developing climate change impact assessments for measuring the benefits of SR actions under future climate change projections; and, g) developing guidelines of the SR actions to ease farmers adaption to the proposed SR actions.

The identified reccomendations encourage the plausible adoption of the SR actions by understanding the government responses on climate change actions and the needs for sustaining rice production in Indonesia. Finally, active engagement among key stakeholders (i.e., government, extension workers, universities, and farmers) with regards to their capacity and role (Figure 3) on rice sector is an essential element to ensure the adoption of the SR actions.

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Conflict of Interests

The authors hereby declare that there are no conflicts of interests.

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Research Paper

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Financial access and food productivity nexus: Evidence from Pakistan

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Agriculture Credit, Food Security, Wheat Production, Cobb Douglas Production Function, Vicious circle

Abstract

Food possesses a great importance in the lives of human beings as it provides energy and strength to the human body to think, grow and develop. The global population is increasing day by day, becoming even more difficult to manage food for every human being on earth. It is the responsibility of every state to provide food for its citizens. "Zero Hunger" is one of the major goals of the Sustainable Development Goals (SDGs') which aims to eradicate hunger from world. Researchers and policy makers identify several causes of food insecurity. This paper explains the importance of financial intermediation in food security as food is a basic human right and one of the foremost major issues of the nations which needs addressed. Pakistan is considered one of those countries which are food insecure, while most of its population is poor and have large family sizes. There are many causes of food shortage and malnutrition like poverty, unemployment, inequalities in income, among others but the most pronounced is the weak agriculture sector and limited financial capacity of majority of its people. Nobel Prize winner "Amartya Sen" discussed the issue of food insecurity concerning poverty (i.e., low purchasing power). However, this paper addresses the issue of food insecurity from the supply side. The study aims to analyze the impact of credit on food production. Financial intermediation can increase food supply by encouraging the use of quality inputs which aids food security. Primary data is collected through a survey, and the Cobb Douglas Production Function is used for econometric analysis. Results indicate that credit plays a significant and positive role in the increase of food production. Production of the borrowers increased after utilizing the credit due to the use of quality farming inputs. Increased production leads to low prices which increases the purchasing power of the people and ensures food security by providing ample quantity of food for everyone and everywhere. It also reveals that credit is not only helpful in achieving the "zero hunger challenge" but also for reducing poverty by increasing the income of the borrowers. The paper concludes with policy suggestions to strengthen the agriculture sector, financial institutions, and credit policies thus ensuring food security.

Introduction

The objective of this article is to examine the relationship between credit and food production as food is one of the fundamental rights and basic human necessities. Without food, the survival of human beings would not be possible. The Food and Agriculture Organization (FAO) was established on the 16th of October 1945 in Quebec, Canada to meet the universal challenge of hunger. The first session of FAO was held from 16th October to 1st November 1945 in which the constitution of the FAO was drafted. The Food Security was defined as

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"when all people, at all times, have physical (social) and economic access to sufficient, safe and nutritious food that meets their dietary needs and food preferences for an active and healthy life" (World Food Summit, 1996). The term "social" was added in the above definition in 2002. According to FAO, 795 million people in the world are suffering from chronic undernourishment due to shortage of food where out of these 780 million live in developing countries (FAO, IFAD, & WFP, 2015). The report further states that, "Every poor person is not hungry, but all hungry people are poor". FAO held several food summits to ensure global food security. During the 1996 summit, which was attended by 112 heads and deputy heads of state, a plan of action was conceived for each nation which emphasizes to adopt individual strategy within the available resources to solve the collective issue of global food security. The plan of action also aimed at eradicating hunger and malnutrition from all over the world.

In September 2000, the United Nations Millennium Summit met in New York as a special session of UN General Assembly. Eight Millennium Development Goals (MDGs') including the first goal of "Eradicate the Extreme Poverty and Hunger", were approved in the Summit. The practical target of this goal was to reduce by half the proportion of the people suffering from hunger between 1990 and 2015. But unfortunately, the MDG to halving the hunger and poverty by 2015 was not achieved by most of the governments. In the year 2016, the number of undernourished people increased from 777 million in 2015 to 815 million which is alarming, but this number is still down from about 900 million in the year 2000. United Nations introduced the Sustainable Development Goals (SDGs') to replace the MDGs. The SDGs' are also known as "Transforming our World: the 2020 Agenda for Sustainable Development" or Agenda 2030 in short. Negotiation on "Post-2015 Development Agenda", begun in January 2015 and ended in August 2015. The final document was adopted in September 2015 in New York (USA) at the United Nations Sustainable Development Summit. 193 countries of the United Nations General Assembly adopted the 2030 agenda which includes 92 paragraphs. Within the agenda, paragraph 51 outlines the 17 Sustainable Development Goals and the 169 associated targets. "Zero Hunger" is the second SDG which is aimed to be achieved by 2030 (UN 2015).

Pakistan is also the signatory of SDGs' and tries to overcome the issue of hunger and poverty. Food policy is integral to achieve this goal. Food policy refers to a plan of action related to food systems (Pinstrup, Andersen, & Watson, 2011). This can include policies related to agriculture, producer subsidies, consumer subsidies, price stabilization, food safety, and resource management. The concept of food policy concerning developing countries, in particular, focused on the accessibility and availability of food, is eventually integrated with production (Maxwell & Slater, 2003). There are different factors which are affecting food availability and accessibility in the country. Issues being faced, regarding food policy, are strongly linked with agricultural issues. Unfortunately, Pakistan did not have any formal national agricultural policy, however, formulated a first draft of Food Security Policy in 2017. Before the formulation of the draft policy, some key issues, which were considered constraints in production and productivity, were identified. Low production is one of those which is further associated with lack of credit.

In Pakistan wheat is used as major food source by the majority of the population. Provision of food has been made part of the constitution as a basic right of every citizen. Article 38(d) of the constitution states; "The state shall provide necessities of life, such as food, clothing, housing, education and medical relief for all citizens irrespective of sex, caste, creed or race, as per permanently or temporarily unable to earn their livelihood on account of infirmity, sickness or unemployment".

Though food is the fundamental right of every citizen of Pakistan, still 22% population of Pakistan is undernourished. Around two-thirds of households in Punjab do not get the proper food and nutrition that is essential for a healthy life. Similarly, around 67.4% of households in Khyber Pakhtunkhwa, 83.4% in Baluchistan and 70.8% in Sindh province do not have access to adequate food (Mishal, 2016).

Food is directly linked with the agricultural sector. Unfortunately, this sector is on the decline for the past two decades in Pakistan. Punjab is producing a major food crop (i.e., wheat), but the production is not enough for the rapidly increasing population. Farmers are facing losses due to which they are converting their lands from food crops to other cash crops like sugar cane, cotton, etc. Moreover, poor technology, old cultivation methods, and financial constraints are some major reasons of low production (Bashir, Ahmed, Hassan, Adil, & Bakhash, 2007). Pakistan will have to counter hunger challenge to meet Sustainable Development Goals which is not possible without strengthening agriculture sector and by removing major constraints (Ahmad, 2011). There are many other causes of hunger and malnutrition such as poverty, unemployment and, inequalities in income, however, weak agriculture sector is the major origin of all these because food is dependent on agriculture (Ahmed & Farooq, 2010).

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Literature Review

Finance is the backbone of every business. Financial support is provided through credit to poor farmers for the purchase of agricultural inputs. Pakistan, being a developing country where farmers have meager income to purchase quality inputs, mostly relies on household seeds and fertilizer (Iqbal, Ahmed, & Abbas, 2003). Due to use of poor quality inputs, production is lower which increases food insecurity. Moreover, 43.5% of the population of Pakistan is dependent on the agriculture sector for their livelihood (Javed, et al., 2006). Furthermore, this sector is contributing a lot towards the Gross Domestic Production (GDP) of the country by employing half of the labor force of the country. Due to financial constraints, these farmers lose their possible income every year and get trapped in a vicious circle of poverty. Hence, credit is a great support for them (Farooq, Ahmed, & Altaf, 2009).

Agriculture growth plays a crucial role in the economic growth of developing countries. This sector is also eradicating poverty and hunger by producing food and income for the poor and low-income farmers (Riaz, Khan, & Ahmad, 2012). Lack of access to financial services is a major constraint in the modernization of agriculture (Bshir & Azeem, 2008). Financial development has a significant relationship with agricultural development. However, access to credit and capital is a perennial problem in developing countries (Smith, Ei, & Jensen, 2000). Most farmers are unable to provide collateral to financial institutions, due to which they cannot produce enhanced yields, and thus, earn a lower income, ultimately falling into a vicious circle of food insecurity. (Yu, You, & Fan, 2009). With the availability of credit, farmers will purchase quality inputs and cultivate the wheat at right time which will increase wheat production thus making farmers food secure (Mittal & Sethi, 2009).

Production costs are increasing day by day due to inflation. The unavailability of financial resources is a key hurdle of less production (Ayaz & Hussain, 2011). Most farmers are excluded from financial services because they are unable to provide collateral. Moreover, credit facility from banks is also not available to lessee or tenants (Ahmed & Heng, 2012). Small and poor farmers often use the age-old methods for agriculture which fail to give optimum production. Such farmers hardly fulfill the food needs of their own families leading to poverty, malnutrition, hunger and perpetual food insecurity. If this problem is not controlled, then food insecurity will lead to severe famine. They work hard in the fields but cannot get potential output because of unavailability of financial help (Ali, Mushtaq, Ashfaq, & Abedullah, 2008). Availability of collateral free credit and the expansion of bank branches in proximity can provide benefits to maximum farmers (Dhrifi 2014). It may be appropriate that the government should open a window of financial services for small farmers and tenants. Such categories of farmers have larger numbers as compared to big landholders but are poorer and more vulnerable as compare to big landlords (Olaoluwa, 2016). Therefore, the inclusion of such farmers in financial services can yield significant results. Low prices of food grains are also discouraging farmers from growing more food as cost of production is increasing every year and farmers face losses in the form of low prices of the food grains (Das, Senapati, & John, 2009). Some farmers borrow money from middlemen or from informal sources which charge high-interest rates. During harvest, farmers are left with little money for their necessities as they pay the major chunk of their income to middlemen to repay the loan amount with high-interest rates. Such situations are regressive and discourage farmers from agriculture occupation (Nadeem & Mushtaq, 2012).

Furthermore, bank credit is playing a significant role in agricultural production as credit fulfills the financial requirements of farmers for agricultural production (S.B.Williams, Ajao, & Ogunniyi 2007). With the availability of financing, farmers use quality inputs which increase their production. Increased production increases the income of the farmers which encourage them to grow more (Kofiakwaa-Sekyi, 2013). The agriculture sector not only provides raw material to the industrial sector but also a means of subsistence for most of the population. Traditional methods of production based on self-reliance are a hurdle for higher productivity. The problem becomes cyclic. Low production in one season leads to poor quality inputs in the following season because of lack of finance and this vicious circle continues (Ali & Iqbal 2005).

In Pakistan, the government provides agricultural credit through different programs like microcredit, National Rural Support Programs, and credit from commercial banks. Farmers who are availing this facility are far better off than those who do not. Increase in production will make a secure food Pakistan that will also be self-reliant (Usman, 2016).

Literature concludes that provision of finance can strengthen the agriculture sector and its production. The definition of food security given by FAO in 1996 reveals the two major dimensions of food security, availability, and affordability. Most of the researchers discussed the definition of food security concerning affordability i.e. purchasing power. Noble prize winner "Amartya Sen" also explained the same concerning poverty. However,

this study emphasized an increase in food production to ensure food security. If ample food would be available, then prices would be lower, and everyone would be able to buy food. Moreover, production at vast scale will reduce the cost of production.

Material and Methods

Credit is one of the important factors of production and also one of the key factors of small-scale businesses and other economic related activities. Various researchers have used different variables to analyze the impact of credit on agriculture production, thus food security. Agricultural credit plays a mediatory role and enhances food security by making quality inputs available when needed. The purpose of this study is to analyze the impact of different variables, such as credit, seed, fertilizers, and pesticides, on farmers' (i.e. borrowers) agricultural production.

Punjab is the major agricultural province which produces a large number of agricultural products as compare to other provinces. Punjab provides wheat to other provinces as the land of other provinces is less fertile and supportive for major food staple of the country (e.g., wheat). The farmers of the district Bahawalnagar obtained the largest amount of agricultural credit from Zarai Tarqiati Bank Limited (ZTBL), which is a major public bank that provides agricultural credit all over the country. A list of borrowers who obtained credit for the wheat crop was obtained from the zonal office of ZTBL situated in Bahawalnagar. The total number of borrowers who obtained credit for the wheat crop was 930. The sample size was found to be 280 by using the following statistical formula.

$$n= N/ 1+Ne2 \quad (1)$$

(where n= Sample Size, N= Total Populating or Sample Frame and e = margin of error

(Population of the study is 930 and error margin is 0.05)
=930/1+930 (0.05)2

= 930/ 1+2.325

=930/3.325

= 279.70

= 280 Approximate Sample Size

District Bahawalnagar comprises of five tehsils, namely Bahawalnagar, Chistian, Fort Abbas, Haroonabad and Minchinabad. Though the population of the district is homogeneous, to avoid any bias, the proportionate sampling technique was used to secure the participation of borrowers from each Tehsil in the sample. The sample size was then divided according to the percentage proportion of each Tehsil in the total sample frame. Afterward, borrowers were randomly selected from each tehsil as per the percentage.

Data Collection Technique

Data were collected through a survey. A detailed questionnaire was designed and face to face interviews were

Table 1: Selection of Sample

Sr.No	Tehsil's Name	Number of Borrowers	Percentage of Each Tehsil in Total Sample Size	Proportionate Sample Size According to the Percentage of Each Tehsil in Sample Size	Round Figure
1	Bahawalnagar	211	22.69	63.53	63
2	Chistian	166	17.85	49.98	50
3	Fort Abbas	262	28.17	78.88	79
4	Haroonabad	116	12.47	34.92	35
5	Minchinabad	175	18.82	52.70	53
	Total	930	100	100	280

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conducted to collect the relevant information from the borrowers.

Data Analysis Method

The Cobb Douglas Production Function (CDPF) was used for econometric analysis. It was proposed by Kunt Wicksell[1] (1851-1926) and tested by two economists namely Charles Cobb and Paul Douglas in 1928[2] against statistical evidence. They gave an abridged view of the American economy in which they determined the output by the amount of labor used and capital invested; their model proved remarkable. This model is used by many researchers and economists to determine the output.

The function given by Charles Cobb and Paul Douglas is:

$$Y(L, K) = bL^{a}K^{b} \qquad (2)$$

Where,
Y= Total Production
L= Labor Input
K= Capital Input

Customized CDPF for this study

$$Y = b_0 C^{b1} S^{b2} F^{b3} P^{b4} \qquad (3)$$

(Where, "y" stands for production, "C" stands for Credit, "S" stands for Seed, "F" stands for Fertilizers, "P" stands for pesticides while $b^{1,}$ b^2, b^3 and b^4 are the elasticities)
By taking Natural Log (ln) from both sides (to transform this model into Multiple Linear Regression Model (MLRM)

$$\ln Y = \ln b_0 + b_1 \ln C + b_2 \ln S + b_3 \ln F + b_4 \ln P + u \ln e \qquad (4)$$

By assuming

$$\ln y = y, \quad \ln b_0 = a$$
$$\ln C = x_1, \quad \ln S = x_2$$
$$\ln F = x_3, \quad \ln P = x_4 \text{ and } \ln e = 1$$

$$Y = a + b_1 x^1 + b_2 x^2 + b_3 x^3 + b_4 x^4 + u \qquad (5)$$

Operational Definition of the Variables

Production (y)
Production was taken as a dependent variable. The per-acre total production of wheat in KGs was asked and used in the analyses. The borrowers obtained this production after utilization of credit.

Amount of Credit (x_1)
Amount of credit was taken as an independent variable. As credit was disbursed according to per acre of agricultural land so per acre total amount of credit obtained in rupees was asked and used in the analyses.

Seed (x_2)
The seed was taken as an independent variable. Quantity and quality of seed both effects the production. The total quantity of seed (in KGs) used in per acre was asked and used in the analyses.

Fertilizer (x_3)
Fertilizer was also taken as an independent variable. Fertilizer increases the fertility and productivity of the land. It also gives strength and protection to seed sown. Total

Table 2: The result of Econometric Analysis (Cobb Douglas Production Function)

Variables	Beta Coefficient	t-value	Sig. (p-value)
Constant	2.729	13.801	0.00
Credit	0.326	13.403	0.00
Seed	0.173	3.759	0.00
Fertilizer	0.185	3.892	0.00
Pesticides	0.051	1.721	0.086

Dependent Variable: Production F-Value= 240.103 R-Square =0.78

1. Refers *http://www.econlib.org/library/Enc/bios/Wicksell.html*
2. ibid

quantity of fertilizer (in KGs) used in per acre land was asked and used in the analyses.

Pesticides (x_4)
Pesticides give protection to seed and crop from insect and various crop diseases. It increases the production by saving the crop. Total quantity (in milliliters/liters) used in per acre land was asked and used in the analyses.

Results

The above table shows the result of MLRM. The constant of the model was found to equal 2.729 with a t-value of 13.801, which is significant at the 5% level of significance. The beta coefficient of credit was found at 0.326 with a t-value of 13.403, which was highly significant at 5% level of significance. It showed that a 1% increase in credit will bring a 32.6% increase in production. Therefore, it is concluded that credit has a positive effect on wheat production, which further leads to food security. The beta value of seed was found to be 0.173 with a t-value of 3.759 which was also significant at 5% level of significance. This indicated that a 1% increase in seed will bring a 17.3% increase in yield production.

Results showed that the beta coefficient of the third independent variable (fertilizer) has a value of 0.185 and t-value of 3.892 which was also significant. It showed that a 1% increase can bring an 18.5% increase in production. Furthermore, the beta value of the fourth independent variable (pesticides) was calculated at 0.051 with a t-value of 1.721. The F-value showed the overall significance of the model. The above result showed that the F-value was found to be equal to 240.103, which is significant at the 5% level of significance, indicating the overall fitness of the model.

R-Square showed the significance of the captured model. The value of R2 was found at 0.78, indicating that all captured variables were highly significant. By summarizing the above results, it is concluded that after utilizing the credit, the production of the borrower farmers has increased (i.e. credit) has significant effects on the production of crops. Moreover, variables such as seed, fertilizer, and pesticides played a positive and significant role in food security by increasing the production of wheat crop.

Discussion

Food provides energy to work, grow, think and develop. It is the first and foremost obligation of the state to provide food to its citizens. Several policies are formulated around the globe to secure the food for every human on Earth. The government of Pakistan is also trying its best to eradicate hunger from the country. Several causes are identified for food insecurity, but low production is one of the major causes. Credit is playing a significant role in enhancing the production of food. Results show that if credit is provided to the farmers, production will increase. Increased production will not only reduce food insecurity and hunger but will also bring prosperity in the lives of farmers by enhancing their income.

Conclusions & Recommendations

Pakistan is a developing country in which most of the population lives in rural areas and is associated with its large agriculture sector. Pakistan is in the list of those countries which are food insecure. Pakistan is the signatory of the SDGs' and "zero hunger" is a major challenge to achieve. Pakistan formulated its first draft of Food Security Policy in the year 2017. The legislation and implementation of the policy is still under process. Pakistan opted the same definition of food security which was given by FAO in 1996 (updated in 2002).

The definition of food security stresses the availability and affordability of food for everyone and everywhere. If sufficient food is available, then prices will go down and everyone would be able to afford to buy it. An increase in food production will ensure the supply of food everywhere. This also indicates that increasing food availability can make Pakistan food secure. As previously mentioned, food is directly linked to the agriculture sector, and financial constraints are one of the major hurdles for farmers in agriculture production. In general, farmers are poor and do not have enough finance to purchase quality inputs (Iftikhar & Mahmood, 2017). When production levels remain low, this not only increases the food insecurity but also increases the poverty in the country.

The Pakistan government is providing credit facilities to farmers through several programs like National Rural Support Program and Punjab Rural Support Program among others. Several commercial and public banks are also providing credit to needy farmers; however, ZTBL is the major bank which is providing the borrowing facilities to fulfill the financial requirements of farmers (Inam, et al., 2018). The study was conducted to reveal the impact of credit on food production. ZTBL disbursed a large amount of credit in the district Bahawalnagar, while wheat is used as the major staple food by the major chunk of the population of the country. Therefore, the borrowers of district Bahawalnagar who obtained credit for the wheat crop are selected as sample. The results indicated that financial access (credit) and other inputs play a considerable role in food security by increasing

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the production of food (wheat). Not only this, but increased production is also reducing poverty by increasing the income of the farmers. ZTBL is, however, charging high-interest rates that need revising as interest rate reduces the profit of the poor farmers. The government may consider providing interest-free loans to support farmers. The loan procedure should also be made easier so that farmers may avail this facility without any hassle. Conditions of collateral may also be relaxed for small farmers. Therefore, it can encourage small farmers to apply for loans, and thus, they will be able to obtain credit. Through this their production and income both may increase. The government procurement system may also be improved so that farmers may sell their products to the government at a reasonable price. Reasonable prices will encourage the farmers to work hard and grow more in the next season.

One of a recommendation is that the government may introduce the concept of collective kitchen, sustainable farming methods and home gardening to ensure food security. This will reduce the cost of food production, processing, preparing and cooking. Land use policy is also essential for food security as conversion of land from agricultural purposes to other commercial activities is also reducing production. Government may also introduce a policy to ban the conversion of lands from food crop to other cash crops. The crop insurance policy may be introduced and made compulsory for every farmer. Females are the vulnerable segment of society. Special credit schemes may be announced for females and disabled persons to give them more empowerment. The government may introduce training and guidance programs for farmers regarding better harvesting and cultivation. All these collective efforts can lead to increase in agricultural production hence making the country more food secure.

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Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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Annotation from the Editorial Board

Future of Food: Journal on Food, Agriculture and Society supports and promotes sustainable agri-food systems.The paper at hand is addressing chemical fertilizer and pesticide application as means of enhancing agricultural productivity in Pakistan. The journal took this paper into consideration to enable discussion on the model provided. Yet the Editorial Board does not endorse the conclusion presented here. Loans to farmers for investments in pesticides are not an ideal approach to achieve food security. In the long run, farmers in Pakistan will need to abandon the conventional agricultural system which connects to vicious circles of poverty and food insecurity.

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Sustainable rural development in Ukraine: Legal aspect

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Abstract

Sustainable rural development involves the attainment of a balanced development of the economic, ecological and social spheres within a community. For this purpose, the state agrarian policy should be aimed at achieving three goals: 1) food security of the state; 2) solving of social and environmental problems in rural areas; and, 3) the transformation of the agrarian sector into a highly effective, competitive domestic and foreign market economy sector of the state. Therefore, the purpose of the article is to study the legal framework for the sustainable rural development of Ukraine by analyzing the state agricultural policy in this area. The article is dedicated to the study of sustainable development`s legal aspects in Ukrainian rural areas. The author clarifies the essence of the concept of sustainable rural development, analyzes the international legislation and legislation of Ukraine in this area. It is noted that the state agrarian policy in Ukraine should focus primarily on ensuring legal, economic and organizational conditions for the development of rural diversification and public-private partnerships. The essence of rural diversification is revealed and its directions are investigated. Legal provision of rural tourism in Ukraine is analyzed in detail. The model of public-private partnership and its potential in the field of rural development is explored. The author concludes that legislation in the field of sustainable rural development is at the stage of formation and proposes a complex of changes aimed at its improvement.

Introduction

Agriculture is a key sector of the Ukrainian economy. The increase in agricultural production is an important factor in ensuring the country's food supply and economic security. The agrarian sector of Ukraine's economy shows the positive dynamics of growth, forming about 14% of gross value added in the country and about 40% of foreign exchange earnings on exports in recent years (Order of the Cabinet of Ministers of Ukraine from 13.09.2017 № 664-p). However, an increase in the volume of agricultural production did not contribute to solving the socio-economic problems of the country's territories.

The rate of remuneration in agriculture remains one of the lowest among the sectors of the Ukrainian national economy. Rural households` income rates per capita (23%) is below the minimum subsistence level. The poverty rate in rural areas is 1.7 times as high as in urban areas. Most rural residents do not have access to high-quality medical or educational services. The state of environmental safety is deteriorating (The Integrated Strategy for the Development of Agriculture and Rural Areas for 2015-2020).

The ill-considered state agrarian policy caused the negative phenomena in agriculture, which were manifested in the unemployment of rural residents, the increase in the amount of rural population`s migration, the decline of social infrastructure, and the disappearance of villages from the administrative map of the state which occurred from 1991 to 2012 due to the lack of population

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528 rural settlements disappeared in Ukraine (Concept of reform of local self-government and territorial organization of power in Ukraine).

In order to address these problems, such situations require an integrated approach as well as the development of legal, economic and organizational measures aimed at the preservation and development of rural areas. Therefore today, the main task of the state agrarian policy should be social problems` solution and the provision of integrated and sustainable rural development. In this aspect, the study of Ukrainian legislation in the field of sustainable rural development, the effectiveness of its application and the definition of the main measures for the state policy implementation are becoming particularly relevant (Stativka & Kulchii, 2016).

The global idea of the sustainable development involves a balanced development of the economic, ecological and social spheres of human life, which provides the needs of the current generation, without compromising the ability of future generations to meet their own needs (UNCED, 1992). Despite consolidating the general understanding of sustainable development in "Our Common Future" Report, its authors emphasized that the interpretations of this category will change, but they should contain some general features and follow from consensus on the basic concept of sustainable development and a broad strategic framework for its achievement (WCED, 1987). That is why, among scholars, there are different approaches to the understanding.

Literature review

Sustainable development is defined as a type of development of a complex system (in other words, the human society and our surrounding environment), which involves not only maintaining the system in a state of dynamical equilibrium, but also a purposeful change based on the application of scientific and technological achievements in the right direction. These achievements provide for a more stable state, and at the same time, functioning more successfully in the interests of both present and future generations (Rutkevich, 2002; Sakhayev, 2004; Melnyk, 2018). Sustainable development is also considered as a dynamic balance of all economic, social and environmental elements in the social system, in terms of such resources use that does not go beyond regenerative and absorbing opportunities of the environment, while simultaneously preserving the possibility of using similar resources for future generations (Todoryuk, 2014). Furthermore, it can be stated as a balanced interaction of society and nature, carried out in the triad of nature, society and man (Lopatynskyi, 2015) as economic growth, which ensures the improvement of the population`s quality of life and its ecological safety (Kuzmenko, 2014; Shevchenko, 2017; Khaustova & Omarov 2018).

Occassionally, sustainable development is understood in two ways: narrow and broad. In the narrow sense, attention is focused mainly on its environmental component (Balyuk, 2011; Yevstihnyeyev, 2012; Malysheva, 2011). Sustainable development is the satisfaction of the basic needs of existing and future generations while preserving the traditional natural resource potential of the biosphere (Sadovenko, 2007; Bystryakov, 2012).). In a broad sense, sustainability is a process that signifies a new type of civilization, in which the task of optimal control is not only natural and resource potential, but also the whole set of natural socio-cultural wealth, which civilization operates at a particular stage of global historical development (Zbarsky & Poozenko, 2011; Barabashova, 2013; Shapovalova, 2002; Shubravska, 2002; Diesperov, 2011; Karpinsky, 2005; Khvesyk, 2012; Spivak, 2010). Sustainable development is a dynamic process of the system`s transition to a qualitatively new innovative level aimed at providing economically sound, environmentally safe and socially-oriented extended reproduction of all elements of the socio-economic system (Samofatova, 2018). However, interpretations of the concept of sustainable development vary. However, it is important to note that in the context of globalization – the rapid pace of global economic growth and excessive consumption of natural resources – that the sustainable development concept was designed to balance civilization development. It is based on the main idea that the dialectical link of the three components (environmental, economic and social) must be considered under all conditions so that not only the current population of the planet, but also future generations have the opportunity to satisfy their own needs (Kulchii, 2015).

In order to adapt national legislation to sustainable development, certain steps have been taken in Ukraine. In particular, it is regulated by such laws as the Resolution of Verkhovna Rada of Ukraine "On the Concept of Sustainable Development of Human Settlements" (December 24, 1999), the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Comprehensive Program for Implementation at the National Level of Decisions Adopted at the World Summit on Sustainable Development for 2003-2015» (April 26, 2003). In addition, the National Commission on Sustainable Development of Ukraine was formed as an advisory body under the Cabinet of Ministers of Ukraine (1997-2002, 2009-2013) and under the President of Ukraine (2003-2007). The main tasks of the Commission were the following: to prepare proposals for the decisions and recommendations implementation of the UN Commission on Sustainable De-

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velopment of the Economic and Social Council; organize the formulation of the main documents, define the strategy of sustainable development in Ukraine; and lastly, to develop proposals as a mechanism for implementing measures aimed at the transition of Ukraine to sustainable development. However, the work of this body proved to be ineffective as its main functions were not fulfilled, and the concept of sustainable development of Ukraine has not yet been developed.

Despite the lack of the National Concept for Sustainable Development, the Verkhovna Rada of Ukraine adopted the Resolution "On the Concept of Sustainable Development of Human Settlements", dated December 24, 1999, which defined the main directions of the state policy on sustainable rural development, as well as legal and economic ways of their implementation. The purpose of the document is declared to ensure the solution to the crisis and to create conditions for the sustainable rural development. However, this concept does not foresee concrete measures for the implementation of sustainable rural development goals, since it does not differentiate sustainable development of rural and urban areas. Meanwhile, the world community distinguishes them at the official level.

Thus, the Food and Agriculture Organization (FAO) has formulated the main ideas of sustainable rural development, which point out that the main objective of the Program of Sustainable Agriculture and Rural Development is to increase the level of food production in a sustainable manner and to ensure food security. To address this challenge, it is necessary to support educational initiatives, the use of economic innovations, and the development of new acceptable technologies, therefore ensuring stable access to food products, meeting the needs in the nutrient elements, access to them by the poor groups, developing commodity production, reducing unemployment, managing natural resources, and environmental protection (FAO, 1999).

Theoretical discussion

The absence of the key categories of sustainable rural development definitions and ways of its implementation at the legislative level in Ukraine led to different approaches among scholars to the essence of understanding sustainable rural development. Sustainable rural development is defined as a complex of social relations that arise in connection with the sustainable development of a community living in rural areas. It also provides growth and increases the efficiency of the agrarian sector of the economy, the level and quality of life, and improves the ecological situation in the countryside (Stativka, 2007). Sustainable rural development is considered as a system of organizational, economic, political and legal measures aimed at ensuring proportional and simultaneous, irreversible and stable progressive changes in the industrial, social and environmental spheres that take place in a proportional and simultaneous manner in each component of the rural territory (Yermolenko, 2010). Some scholars provide an expanded definition of sustainable rural development and by it they mean socio-economic development, in which the effective functioning of the rural economy is ensured. This includes ensuring food security, reproduction of human resources, improving the quality of manpower, full and productive employment of the able-bodied population, raising the level and quality of life in rural areas, rational use and reproduction of natural resource potential of the village, and the development of infrastructures (Bystrov, 2013). Other scholars propose to understand sustainable rural development as socially, economically and ecologically balanced development, that is, irreversible, directed, natural change of territories located outside the cities, which includes both rural settlements, and mainly areas of agricultural production and rural development, aimed at their economic potential`s increase, a valuable living environment for current and future generations on the basis of rational use of resources (natural, labor, product, scientific, technical, intellectual, etc.), technological upgrading and restructuring, improvement of social, industrial, transport, communication and information, engineering, environmental infrastructure, improve living conditions, recreation and rehabilitation, conservation and enrichment of biological diversity and cultural heritage (Urkevych, 2010).

Sustainable rural development involves social relations that arise in connection with the implementation by the state, with the participation of territorial communities and individual economic entities, of a set of economic, social, environmental, institutional and legal measures, in order to ensure the socio-economic growth of the rural areas` development, employment and quality of life of the rural population while preserving natural resources (Savelyeva, 2017). The concept of sustainable rural development is based on the unity and balanced development of three components - economic, ecological, and social. An economic component of sustainable agricultural development must ensure the profitability of production; to achieve economic sustainability, agricultural producers must apply methods that increase the productivity of their production, that is, the diversification of production and markets. The social component of sustainability is aimed at ensuring a high standard of living for workers, conflict-free sustainable socio-cultural relations, farmers` participation in a variety of local activities, which will have a positive impact on the local community. The essence of the ecological component of

sustainable development should be aimed at preserving the integrity and viability of biological and physical natural systems, from which the stability of the biosphere depends globally, as well as on preserving their ability to change and self-healing (Cherniatina, 2018).

Therefore, sustainable rural development involves integrated development of economic, social and environmental spheres of the village, which should proceed in interaction and interconnection in order to use the natural resources of the rural areas for meeting of the current generation`s needs and be carried out without compromising the ability of future generations to meet theirs.

Regulatory prerequisite for sustainable rural development`s legislation formation in Ukraine is the Law of Ukraine "On the priority of social development of the village and agro-industrial complex in the national economy" (17.10.1990), in the preamble of which it is stated that the priority of social development of a village and the agro-industrial complex objectively follows from the exceptional significance and indispensability of the agricultural products produced in the life of a man and society, the need for the revival of the villager as the landlord, the bearer of morality and national culture.

Subsequently, in order to develop the agrarian sector effectively by ensuring the unity of the economic, social and environmental interests of the society in order to ensure the stable provision of high-quality, safe and affordable domestic agricultural products and agricultural raw materials to the population, the Cabinet of Ministers of Ukraine adopted an Order (as of 17.10.2013), that approved The Strategy of the agrarian sector of the economy development up to 2020.

The Decree of the President of Ukraine dated January 12, 2015 "On the Strategy of Sustainable Development" Ukraine-2020" defines the purpose as vectors of the movement. Roadmaps, priorities, and indicators of appropriate defense as well as socio-economic, organizational, political and legal conditions for the establishment and development of Ukraine are considered vectors of development including the reform of agriculture. In order to implement the Strategy, the Cabinet of Ministers of Ukraine adopted an Order dated September 23, 2015 "On Approving the Concept of Rural Development", which outlines the main priorities of rural development and the mechanism of preparation of the agrarian and rural sector for functioning in the conditions of the EU free trade zone. The purpose of the Concept is to create the necessary organizational, legal and financial prerequisites for rural development through diversification of economic activity; increasing the level of real incomes from agricultural and non-agricultural activities in the countryside; achievement of guaranteed social standards and improvement of living conditions of rural population; environmental protection, conservation and restoration of natural resources in rural areas; preserving the rural population as a carrier of Ukrainian identity, culture and spirituality; creation of conditions for the expansion of the opportunities of the territorial communities of the village to solve the existing problems there; and bringing rural development legislation into compliance with the EU standards.

In addition, agriculture issues are defined in Chapter 17 of the Association Agreement between Ukraine, on the one hand, and the European Union, the European Atomic Energy Community and their member states, on the other hand (ratified by the Law of Ukraine No. 1678-VII of 16.09.2014). According to Art. 404 of the Agreement, cooperation in the field of agriculture and rural development covers, among other things, such aspects as the promoting of modern and sustainable agricultural production, taking into account the need to protect the environment and animals; improving competitiveness of the agricultural sector, efficiency and transparency of the markets, investment climate; as well as sharing knowledge and best practices on rural development policy in order to promote the economic well-being of rural communities.

By the Order of the Cabinet of Ministers of Ukraine (dated September 13, 2017, No. 664-p), the Concept for the Development of Farms and Agricultural Cooperatives for 2018-2020 was approved. Its purpose is to create all necessary organizational, legal and financial prerequisites for the development of farms and agricultural cooperatives, and improve the financial and financial situation of the rural population by providing support to farms; generating employment in the countryside, in particular, through stimulation of agricultural co-operation; diversification of the activity of farms; creating prerequisites for crediting farms at affordable interest rates; increase the level of real incomes of rural population from the transfer of agricultural land lease.

Non-farm rural activities as a measure to implement state policy in the field of sustainable development of rural areas of Ukraine

The implementation of the foreseen measures is undoubtedly important for the achievement of sustainable rural development goals. Taking into account the critical condition in rural areas today, Ukraine's state agricultural policy should focus primarily on ensuring legal, economic and organizational conditions for the development of

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non-farm activities and public-private partnerships.

Non-farm rural activities are the activities of agricultural producers on the diversification of their operations, as well as provision of services in the field of rural tourism. It should be noted that the World Community in various documents emphasizes non-farm activity as one of the ways to promote rural development . In particular, "Our common future" report states that continuous economic growth and the introduction of non-farm rural activities, as well as the development of technological and managerial skills, will help developing countries mitigate tensions in rural areas, while improving productivity and standards of consumption (WCED,1987). Where intensification of farming systems is not possible, other on-farm and off-farm employment opportunities should be identified and developed, such as cottage industries, wildlife utilization, aquaculture and fisheries, non-farm activities (e.g., light village-based manufacturing), farm commodity processing, agribusiness, recreation and tourism, etc. (UNCED, 1992).

Thus, attracting all available resources (material, labor, natural, etc.), agricultural producers can carry out diversification of production (agricultural) activity; diversification of non-agricultural activities which are unrelated to production and cultivation of agricultural products; and, provision of services in the field of rural tourism. The diversification of agricultural activity is the optimal redistribution of resources and enhance the potential of agricultural producers in other areas of agriculture to eliminate business risks and increase profitability. Diversification of agricultural activities can be carried out. First, through product differentiation, new types of products release within the same industry. Secondly, going beyond the main activity, there is penetration into the new branches of agriculture. As for the diversification of non-farm rural activities, it should be noted that it manifests itself in the redistribution of enterprise resources in other business activities (Kulchii, 2015).

The development of non-farm rural activities in Ukraine proposes to diversify and develop the rural economy by creating conditions for the development of various types of economic activity and forms of management; development of rural tourism and recreation activities; assistance to the formation of solid biofuel sales markets; improvement of the tax and budget system to fill the budgets of territorial communities of villages and settlements; providing support for the development of agricultural servicing cooperation by stimulating the creation of supply, procurement and distribution infrastructure on the basis of cooperation; introduction of economic incentives for the implementation of land protection measures; and, facilitating the access of rural population to financial resources, including traditional and alternative lending mechanisms, involving socially responsible businesses and banks (Gafurova, 2014).

Currently one of the promising directions of the development of non-farm rural activities in Ukraine is the development of rural tourism. Its legal regulation is carried out by a large number of normative and legal acts, due to the lack of a specific law in this area. Among these acts and laws are: The Constitution of Ukraine, the Law of Ukraine "On a personal rural economy" (15.05.2003), the Law of Ukraine "On Tourism" (15.09.1995), and the Resolution of the Cabinet of Ministers of Ukraine "On Approval of the Procedure for the Provision of Services for Temporary Accommodation (Accommodation)" (15.03.2006), among others. However, these regulatory acts regulate the relations in the field of rural tourism only on a general basis, without reflecting their specifics (Tuieva, 2016). The absence of a special legislative act in the area under study leads to contradictions in the legal regulation of rural tourism. Thus, the Law of Ukraine "On Tourism" separately allocates rural and green tourism, the latter is considered as a synonym for environmental tourism. In this case their definitions are not given among the types of activities that private rural farms can deal with. The Law of Ukraine "On Personal Rural Farming" provides provision of services in the field of rural green tourism. Thus, the legislator identifies concepts of "green" and "rural" tourism. This tendency can also be traced in the analysis of other normative legal acts.

Research in the field of rural tourisms' legal regulation gives grounds for formulating the conclusion of a large number of general legal acts that do not reflect the specifics of these relations. This results in fragmentary legal regulation, which is accompanied by the absence of a single categorical apparatus in the field of study and automatic replacement of the concepts that contradict both the requirements of the legislative technique and the established international experience. Rural tourism should be considered as a type of tourism, consisting of rest in rural areas that involve holidaymakers to rural life and meeting their recreational needs associated with the use of the potential of the region and / or property of agricultural producers. In addition, the structure of legal relations, linked with the provision of services in the field of rural tourism, are characterized by the presence of special subjects, the object and content of such legal relationships (Kulchii, 2015).

The peculiarity of the rural tourism`s subject matter is that the producers of agricultural products themselves have the opportunity to provide services in this area. Ac-

cording to the Law of Ukraine "On Agricultural Census" (23.09.2008), such agricultural producers are legal entities of all organizational and legal forms of management and their separate subdivisions. This includes individual entrepreneurs and households that are engaged in agricultural activity, provided in accordance with the classification of types of economic activity, owning, using or disposing of agricultural land or farm animals.

Since rural tourism is a type of recreation that is accompanied by familiarization with customs, traditions, culture, and the everyday life of local people, it seems that among the producers of agricultural products such services can be provided by either farms (as entrepreneurs who can provide services on a temporary basis - catering, sightseeing, entertainment and other tourist services), or private rural households, as individuals who are not subjects of business activity and provide services for temporary accommodation, food etc. The object of relations in rendering services in the field of rural tourism is a specific tourist product, that is, the reason why relationships in the field of rural tourism appear and develop. A tourist product is a pre-designed tourist services complex, combining at least two such services that are being sold or offered for sale at a specified price, which includes transportation services, accommodation services and other travel services not related to transportation and accommodation (services for organizing visits to cultural objects, recreation and entertainment, sale of souvenirs, etc.) (Article 1 of the Law of Ukraine "On Tourism").

Rural tourism is characterized by the presence of a specific tourist product because such type of tourism is carried out in rural areas. When developing a tourism product, an entity that provides services in the field of rural tourism must necessarily take into account the characteristics of resource potential of rural areas, target audience and duration of tourists` stay. These components are the key to the travel programs' development. Therefore, depending on the tourist product in rural tourism, it is possible to distinguish between the following areas: farm tourism, ecological or green (in case it is carried out in rural areas) tourism, ethno-tourism, recreation and others. The content of relations in the field of rural tourism are the rights and obligations of the parties, which acquire their legal form by concluding an agreement on rendering services in the field of rural tourism. Such agreement is made in accordance with the requirements of the civil law of Ukraine, its form can be both oral and written.

The analysis of the legal provision of rural tourism provides grounds for arguing that it is one of the main areas of diversification of rural areas, aimed at increasing employment of villagers and providing services in this area. However, due to the lack of coordinated state agricultural policy nowadays, rural tourism's opportunities for rural development are not sufficiently utilized. Implementation of the state agricultural policy in the field of sustainable rural development is possible on the basis of several measures` formulation and implementation, a special place among which takes the diversification of rural areas, which should be considered not only as the way to overcome the crisis in agriculture but also as a specific activity of the relevant subjects aimed at the integrated development of rural areas.

Public-Private Partnership as a measure to implement state policy in the field of sustainable development in rural areas of Ukraine

Ukraine is unable to implement the main principles of sustainable rural development on a unilateral basis. This process requires well-established cooperation between public authorities, local self-government bodies, agricultural producers and rural residents on the ground of public-private partnership. In Ukraine, the model of public-private partnership began to spread with the development of an appropriate regulatory framework, the basis of which is the Law of Ukraine "On State-Private Partnership" (01.07.2010). This defines the organizational and legal framework for the interaction between state and private partners and the basic principles of the public-private partnership on a contractual basis. In contrast to the established international term "public-private partnership", domestic legislation operates under the category of "state-private partnership", defining it as a cooperation between the state of Ukraine, the Autonomous Republic of Crimea, territorial communities in the person of the relevant state bodies, and local self-government bodies (state partners) and legal entities. This excludes public and communal enterprises, or individual entrepreneurs (private partners) which are carried out on the basis of a contract in a manner stipulated by this Law and other laws, and bears all signs of public-private partnership established by this Law.

According to some scholars, the features of state-private partnership in domestic legislation show that this form of cooperation between the state and private business is aimed primarily at satisfying the interests of the state. After all, the state itself as a public partner in the person of corresponding authorities aims at providing higher technical and economical rates of business activities` efficiency than it would do so in case of implementation of such activities by a state partner without a private partner. The state as a public partner expects a private partner to invest in partnership objects, using legal sources,

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therefore, it transfers some of the risks which arise in the process of implementing public-private partnerships to a private partner. The interest of a private partner in the implementation of public-private partnerships is only theoretically foreseen by the law, since such partner is engaged on a competitive basis (that is, it has to win the competition) for cooperation with the state partner on the basis of long-term relations (from 5 to 50 years) (Kulinich, 2014).

The obvious drawback of the Law is the lack of consolidation of agricultural activity as a sphere of public-private partnership (the law only provides for the operation of irrigation and drainage systems). It is noted that according to the decision of the state partner public-private partnership can be applied in other spheres of activity. The analysis of the above-mentioned norm gives grounds to assert that an initiative to use the public-private partnership model for the rural development should come from the state authorities or local self-government bodies. The given situation not only limits the possibility of using this mechanism, but also contradicts the key principles of the Common Agricultural Policy of the European Union, the application of which is important in the context of adapting national legislation to the EU legislation (Sakhayev, 2004).

Thus, in "The future of the rural society" (1988) published by the European Commission, the attention was drawn to the need to develop a European rural development policy that would recognize the socio-economic inequalities among regions, disproportions to urban and rural development, poverty, migration and unemployment of rural residents. The solution of these problems was supposed to be carried out with the help of new measures, in particular, by developing a community-based approach to addressing the problems of rural areas, involving local initiatives, conducting information and educational activities, creating and implementing new infrastructure objects, introducing education and vocational training measures, and developing integrated rural development programs through the involvement of rural communities in the process of solving urgent problems (CEC, 1988). To implement these measures in order to ensure the sustainable rural development and to address the problems of settlements effectively, the European Union developed the Leader II, Leader II, Leader +, rural development programs, the main objective of which included involvement of the public in problems solving, using the "bottom-up" principle by selecting the most perspective plans for the settlements development and their financing from special structural funds. As European experience shows, the model of public-private partnership in attracting local initiatives has become effective for the sustainable rural development (CEC, 1999; 1698/2005 EC; 2006/144/EC).

However, in the absence of proper organizational and legal support in Ukraine, it is still not possible to implement a positive European experience. Although attempts to regulate the involvement of local initiatives in addressing rural problems are traceable in national legislation. The Decree of the Cabinet of Ministers of Ukraine "On Approval of the Concept of Rural Development" (23.09.2015) provides for the improvement of rural areas management system, in particular, by legislative and regulatory support for the rural development; strengthening the role of territorial communities of villages, settlements in planning and implementing rural development measures; promotion of public-private partnership for implementation of rural development projects and fund raising; and, creating a rural development fund.

In spite of the urgent need to consolidate the rural development plan, ways and means of solving problems, it is evident that the priority of rural development remains a declared norm, as the relevant Decree "On Approval of the Plan of Measures for the Implementation of the Concept of Rural Development" was adopted only on July 19, 2017. Thus, the measures approved by the Concept were not actually implemented for two years. In addition, the adopted document does not provide for measures to promote the development of public-private partnership for the implementation of rural development projects and fund raising. This situation is unclear, as the implementation of approved measures is planned to be realized through state and local budgets. However, in a difficult period for Ukraine, it is especially important to attract additional sources of funding, in particular, using the mechanism of public-private partnership.

Findings

Public-private partnership can be useful in the field of ensuring food supply security of the state, technical and technological modernization of agricultural production, innovation activity, development of rural areas and social sphere of the village, the introduction of new breeds of agricultural animals and varieties of agricultural plants, and development of the agrarian market infrastructure, among others. (Kurman, 2017).

It is possible to attract private entities into rural development activities, in particular, in implementing the following measures: 1) to strengthen the material and technical base of cultural institutions and the introduction of modern information technologies in their activities;

2) renovation and modernization of engineering networks and water treatment facilities by provision of rural population with adequate quality drinking water; support the establishment and functioning of rural centers for the provision of housing and communal services and increase the level of provision of such services; 3) development of social services in a rural community; 4) organization of work on the removal of unusable or prohibited pesticides and agrochemicals accumulated from previous years from the places of their storage; 5) the creation and operation of museums of nature, museum rooms, eco-education centers, ecological and educational classes, ecological and educational paths in the territories and objects of the nature reserve fund; 6) the design and construction of water supply and sewage treatment facilities, including local and other objects of the drainage system in the countryside, using modern technologies and equipment; and, 7) assistance in the formation of the raw material base for the production and use of biofuels for the communal sphere and the rural population heat supply. However, for their implementation, "The Plan of Measures to Implement the Concept of Development of Rural Areas" should be amended accordingly.

In addition, it is appropriate to provide for the development of pilot rural development projects based on public-private partnerships that will stimulate non-rural activities in rural areas, based on the following arguments. First, support for diversification of the rural economy, in particular through the development of non-agricultural activities (tourism, storage, processing, marketing of agricultural products, folk crafts, harvesting, processing of wild fruits, berries, medicinal herbs, harvesting and processing of timber, manufacturing of building materials, construction, etc.) can promote the development of rural areas by increasing the number of jobs and the infrastructure development. Secondly, the development of other types of activities in rural areas is one of the ways to ensure sustainable development of rural areas, since, as stated in the Agenda 21, in order to meet the future demand for commodities, intensification of agriculture is required through the diversification of production systems in order to achieve maximum efficiency in using local resources, while minimizing environmental and economic risks at the same time. (UNCED, 1992). Thirdly, the state, supporting the mechanism of public-private partnership as a way of ensuring sustainable rural development, will thus continue the process of transformation of the rural development model from the sectoral (rural areas as considered exclusively as resources for agriculture) into territorial (rural development as identified with development of rural areas in general, through the use of all resources located in a specific region – human, physical, natural, landscape, etc.) and consequently, the integration of all components and branches at the local level is achieved (Mantino, 2010).

Conclusion

The main components of the state agricultural policy are a set of legal, organizational and economic measures aimed at improving functioning of the agrarian sector, solving social problems of the rural population and ensuring the integrated development of rural areas. In turn, the state policy of sustainable development of rural areas in Ukraine should include three aspects: economic, social and environmental. In economic terms, it is advisable to distinguish agrarian policy and non-agricultural activities development policy. The basis of economic development is the effective use of human and natural resources of the locality to create jobs and ensure an adequate level of well-being. Development of the social sphere should be aimed at improving the living conditions of the rural population and meeting its needs. The ecological component should include the rational use of natural resources, environmental protection and environmental protection of rural areas. However, legal regulation`s analysis of sustainable rural development gives grounds to argue that there is no systematic approach in this area due to the lack of coordinated state agricultural policy.

Summing up what has been said, the development of non-farm rural activities and a model of public-private partnership can become the main means of ensuring sustainable rural development in Ukraine, as they will encourage fund raising from private persons to implement state and regional rural development programs. This, in turn, will contribute to sustainable rural development. However, to achieve such synergistic effect, it is necessary to improve national legal framework.

Consequently, the legal direction for improving the mechanisms for implementing the state policy of sustainable rural development in Ukraine should be the drafting and adoption of the Law "On Sustainable Rural Development", in which it is advisable to consolidate key concepts "rural territory", "sustainable rural development", "state policy of sustainable rural development" and to provide ways and means of the Program of rural development realization. The study was an attempt to explore the legal aspects of sustainable development of rural areas in Ukraine. However, further scientific researches need the perfecting of definition of the sustainable rural development, organizational and legal provision of rural tourism and others non-agricultural activities in rural areas, forms of public-private in agriculture for improving the directions of the state sustainable rural development policy.

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Conflict of Interests

The author hereby declares that there are no conflicts of interests.

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Carbon footprint for wheat and corn under Egyptian conditions

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Abstract

Egyptian agriculture faces the challenge of ensuring food security while mitigating greenhouse gas emissions under climate change. Using life-cycle analysis to characterize the carbon footprint of crop production is critical to identify key measures which mitigate greenhouse gas emissions while sustaining crop productivity in the near future. Agriculture contributes a significant share of greenhouse gas emissions and concurrently represents a carbon dioxide (CO_2) sink, and thus, it has two fold opposing impacts on climate change. The carbon footprint of agricultural products is one of main measures for monitoring the efficiency and sustainability of agricultural productivity processes. Studies on the sustainability of crop production systems should consider both the footprint and the crop yield. In this study, 10-years of wheat and corn cultivated areas and yields were examined/analyzed from the statistics of the Ministry of Agriculture and Land Reclamation. To estimate greenhouse gas emissions, Egypt is divided into four regions; Delta, Middle, Upper Egypt, and lands outside the Nile Valley. The greenhouse gas emissions for both crops were estimated from different sources, including Nitrous oxide N_2O (synthetic fertilizers, manure fertilizer and crop residues) and carbon dioxide from fuel consumption (operation machinery and water pump). The results indicated that synthetic fertilizer had the highest greenhouse gas emissions at 47.2 and 45.5% for wheat and corn, respectively. Furthermore, the manure fertilizer presented the second source of greenhouse gas emissions with values of 35.4 and 33%. The lowest emissions were released from the fuel consumption (4.4 and 4.8%) for wheat and corn, respectively. The carbon footprint for wheat was 0.239 and 0.307 kg CO_2eq /kg grain yield for corn.

Introduction

Maize and wheat are cultivated in all agro-climatic zones (Delta, Middle, and Upper Egypt) in Egypt from North to South. The cultivated area of maize in 2017 was 794,704 hectares with an average productivity equal to 8.1 t/ha . The cultivated area of wheat was 1,257,277 hectares with average productivity of 6.5 t/ha in 2017.The agriculture and livestock sectors are large contributors of nitrous oxide (N_2O) and methane (CH_4) emissions in countries with agricultural activities. Such remedial measures are needed in these sectors to curb contributions to global warming (Kanyama and González, 2007). The particular in areas where the global warming potential that is related to agricultural activities is relatively high (e.g. nitrous oxide emission from the soil and manure storage, methane emissions from manure storage and enteric fermentation). This includes areas where about 13% of the annual global warming potential is related to all human activities (Olivier et al., 2005). Greenhouse gas emissions contribute to global warming by about 7% by converting natural habitats

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into permanent agriculture. The anthropogenic greenhouse gas emissions contribute to soil organic carbon decay and peat oxidation by approximately 10% (based on IPCC, 2007; FAO, 2001).

Sustainability of agricultural systems depends on their carbon (C) footprint, and the C_{output} :C_{input} ratio. The carbon footprint of agricultural products is one of main indicators for monitoring the efficiency and sustainability of agricultural productivity processes. Greenhouse gas emissions are one of the key indicators in assessing the environmental sustainability of farming. In order to quantify the impacts we define and use the term "carbon footprint". These are the most commonly used terms in the full "Life-Cycle-Assessment" (i.e., LCA) analysis for quantifying the impact of farming activity on the environment. (Gómez-Limón and Sanchez-Fernandez, 2010). However, product carbon footprinting currently faces some major drawbacks that drive some experts to see CFP as a "wasteful distraction" and that it would be better to devote management time and resources to other decarburization initiatives (McKinnon, 2010).

The Life Cycle Assessment (LCA) was recognized as an appropriate tool to estimate the climate impact or carbon footprint of crop production (Hillier et al., 2009). Therefore, the carbon footprint has been defined as "a measure of the exclusive total amount of carbon dioxide emissions that was directly and indirectly caused by an activity or was accumulated over the life stages of a product" (Wiedmann and Minx, 2008). The life cycle of wheat included production, transportation, use of machinery use and manufacture released GHGs through burning of fossil fuel during field operations, and the manufacture of farm equipment (e.g. tractors). All on-farm operations, including application of pesticides and fertilizers, were integrated into this LCA (Ho, 2011).

The agricultural sector is vital to sustainable human existence, therefore, we cannot ignore the real and substantial role that agriculture plays in GHG emissions nor the potentially catastrophic effects on food security and sustainability if planning for the sector does not consider climate change (Moreau et al., 2012). The carbon footprint and assessment standard is one of the most basic and crucial research in low-carbon research. However, due to this issue consistent results have not been achieved yet, and hence, concerned research were greatly affected. Research on the carbon footprint and assessment standards has become a hot topic for governments and researchers. More importantly, to make general public is becoming more aware and concerned about the effect of farming on environmental sustainability and society health as a whole. This paper describes the structure of the model calculation of the carbon footprint of agricultural products (wheat and corn) and the establishment of a database for Egypt. The results present an assessment of the carbon footprint of grains (wheat and corn) by using farming data at different agro-climate zones in Egypt.

Methodology

Study area

This study focuses on the cultivated areas for wheat and corn in Egypt. Statistics were collected from the Ministry of Agriculture and Land Reclamation from the years 2006 to 2015. Greenhouse gas emissions were calculated in four regions: Delta, Middle, and Upper Egypt, and lands outside the Nile Valley as shown in Figure (1). Egypt has been divided into several agro-climatic regions according to the average temperature values. The most important agro-climatic regions are: the Delta region (30°N – 31°N), represented by seven governorates (Kafr El-shiekh, Dakahlia, Sharqia, Ismailia, Portsaid, Suez and Cairo); the Middle Egypt region (28°N – 30°N), represented by four governorates (Giza, Fayoum, Beni Suif and Menya) and the Upper Egypt region (24°N – 28°N) represented by five governorates (Asyut, Sohag, Qena, Luxor and Aswan) (Abdrabbo et al., 2015). Table (1) demonstrates the average cultivated area, production and yield for wheat and corn in four regions over ten years.

IPCC (2006) suggests different approaches to calculate emissions. These approaches are called Tier 1, Tier 2 and Tier 3, with increasing levels of detail and complexity. Tier 1 is suitable for cases in which either no detailed data are available or global results are sought, though significant variations, such as climate, region, type of harvest and animal rearing, irrigation procedure, soil and manure management are considered. In this approach, agronomy data from global databases can be used (for instance FAO data). Under Egyptian conditions, Tier 1 is suitable to calculate emissions.

Nitrous oxide (N2O) from synthetic fertilizers applied on soils

The application of nitrogen fertilizer increases the probability of nitrous oxide N_2O emitted from microbial activity in soils. However, a fraction of direct volatilization as ammonia and nitrogen oxide must be subtracted as the microbes in the soil do not use this. Then, the amount of nitrous oxide N_2O emitted from the application of nitrogen fertilizers is given by the following equation (1) according to (IPCC 2006):

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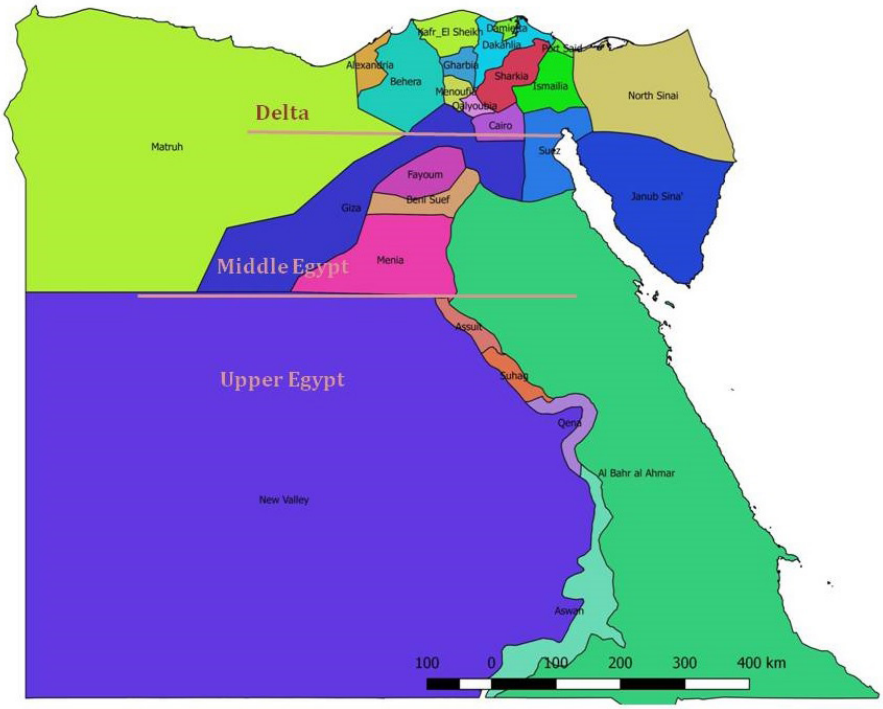

Figure 1: Different Egyptian regions; Delta, Middle, and Upper Egypt and lands outside the Nile Valley (Source: GIS unit, Central Laboratory for Agricultural climate, Agriculture Research Center)

$$N_2O_{fertil} = M_{fertile} * (1- fr_{atm, f}) * \varepsilon_{factor} * (M_{N_2O}/ M_{N_2}) * GWP_{N_2O} \quad (1)$$

Where

M_{fertil} = mass of nitrogen in fertilizer needed to produce the amount of product analyzed (kg N applied/ kg product analyzed)

$fr_{atm'f}$ = fraction of nitrogen that is released into the atmosphere as NH3 or NOx, (from Table 11.3, Chapter 11 of (IPCC, 2006)

ε_{factor} = emission factor for fertilizer, i.e. kg of N2O-N per kg N applied (from Table 11.1 chapter 11 of IPCC, 2006

M_{N_2O}/ M_{N_2} = 44/28 is the mass ratio of nitrous oxide N_2O and N_2

$GWPN_2O$ = Greenhouse Warming Potential of N_2O with respect to CO_2

Nitrous oxide (N2O) from application of manure on soils

The amount of N_2O emitted from application of manure fertilizer on soils is given by the following equation (2) according to (IPCC 2006):

$$N_2O_{m, fertil} = M_{manure} * (1- fr_{atm,m}) * \varepsilon_{factor} * (M_{N_2O}/ M_{N_2}) * GWP_{N_2O} * N_{manure} \quad (2)$$

Where:

M_{manure} = mass of manure needed to produce the amount of product analyzed (kg manure per kg product analyzed)

$fr_{atm', m}$ = fraction of nitrogen from manure applied that is released into the atmosphere as NH or NOx (from Table 11.3, Chapter 11 of IPCC, 2006)

ε_{factor} = emission factor for converting nitrogen, i.e. kg of N2O-N per kg N applied

M_{N_2O}/M_{N_2}= 44/28 is the mass ratio of N_2O and N_2 $GWPN_2O$ = Greenhouse Warming Potential of N2O with respect to CO_2

N_{manure}= fraction of nitrogen per unit of manure (kg N/ kg manure)

Nitrous oxide (N_2O) from crop residues applied on soils

These emissions are released from the additional nitrogen when crop residues are left on soils. Since no-till techniques are becoming common practice in modern agriculture, their contribution might be significant. The calculation for emissions in residues is based on the estimate of N left in the dry matter of the above-ground (AG) and belowground (BG) crop residues. The mass of N in residues per year and hectare, $M_{N,residue}$, is given by the following equation (3) according to (IPCC 2006):

$$M_{N,residue} = Y_{fresh} * f_{dm} * [R_{AG} * N_{AG} + R_{BG} * N_{BG}] \quad (3)$$

Table 1: The cultivated area, production and yield for wheat and corn in four regions

Cities	Area (ha)	Product (ton)	Yield (ton/ha)
Wheat			
Delta	700,651	4,812,280	6.9
Middle Egypt	226,689	1,576,791	7.0
Upper Egypt	221,011	1,451,801	6.6
Outside valley	108,925	610,128	5.6
Egypt	1,257,277	8,450,999	6.5
Corn			
Delta	391,295	3,447,527	8.8
Middle Egypt	228,869	1,774,365	7.8
Upper Egypt	146,279	1,092,874	7.5
Outside valley	28,261	240,321	8.5
Egypt	794,704	6,555,088	8.1

Where:
Y_{fresh} = yield for crop in fresh weight (kg crop / ha)

f_{dm} = fraction of dry matter (DM) in crop

R_{AG} = ratio of above-ground DM residues to harvested crop DM.

N_{AG} = N content of above-ground residues (kg N/ kg DM)

R_{BG} = ratio of below-ground DM residues to harvested crop DM

N_{BG} = N content of below-ground residues (kg N/ kg DM)

Data for all factors is shown in Table 2. Once the application of the emission intensity estimates the content of N in residues is obtained by multiplying by the corresponding mass and GWP factors.

$$N_2O_{N,\,residue} = M_{N,residue} * \varepsilon_{factor} * (M_{N_2O}/M_{N_2}) * GWP_{N_2O} * M_{crop} / Y_{fresh} \quad (4)$$

Where:
ε_{factor} = emission factor for converting nitrogen into N_2O (equal to 0.01 kg of N_2O-N/ kg N, from Table 11.1 Chapter 11 of IPCC, 2006)

M_{N_2O}/M_{N_2} = 44/28 is the mass ratio of N_2O and N_2

GWP_{N_2O} = Greenhouse Warming Potential of N_2O with respect to CO_2

M_{crop} = fraction of product analyzed per unit of crop harvested (kg crop/ kg product analyzed)

Emission from fuel consumption

Power requirements and fuel used per hectare for specific farming tasks are shown in Table 3 (Grisso et al., 2014). Assumed typical conditions and average working depths may be used to make fuel estimates for the indicated operations. Predicting fuel consumption for a specific operation can be estimated using the following calculation according to ASABE Standards (2006, 2009). The equation has been used widely for estimating fuel consumption (5):

$$Q_{avg} = 0.305 \times P_{Ene} \quad (5)$$

Where
Q_{avg} = average diesel fuel consumption, L/h
P_{Ene} = maximum Engine power, kW

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Table 2: The factors for equation of Nitrous oxide (N2O) from crop residues applied on soils

	f_{dm}	N_{AG}	R_{BG}	N_{BG}
Corn	0.87	0.006	0.22	0.007
Wheat	0.89	0.006	0.23	0.009

*source Chapter 11(table 11.2): N2O Emissions from Managed Soils, and CO2 Emissions from Lime and Urea Application (IPCC, 2006)

Table 3: Average energy-use rates and fuel requirements for farming tasks

Operation	Farm energy audita Average from (gal/ac)	L/ha
Primary tillage		
Chisel disk	1.1	10.45
harvesting		
Mower	0.5	4.75
Small grain or bean combine	1.51	14.345
Thresher	1.4	13.3
Water pump	1.5	14.3

Source: Helsel, Z., and T. Orguntunde 1958. Fuel requirements for field operations with energy saving tips. InFarmEnergy Use: Standards, Worksheets, Conservation, ed. C. Myers. East Lansing: Michigan State University.blowa, Pennsylvania, Nebraska, Missouri, New York, Oklahoma, North Dakota, and Ontario, Canada.

$$Q = (0.22\ X + 0.096) \times P_{Ene} \quad (6)$$

Where
Q = diesel fuel consumption at partial load, L/h

X = the ratio of equivalent Engine power to rated Engine power, decimal

P_{Ene} = the rated Engine power, kW

Power requirements for thresher and mower:

The following equation (7) is used to estimate ending used engine power (EP) according to Donnell (1983).

$$EP = [f.c(1/3600)\ PE \times L.C.V \times 427 \times \eta thb \times \eta m \times 1/75 \times 1/1.36] \quad (7)$$

Where
f.c = The fuel consumption, (L/h)

PE = The density of fuel, (kg/L) (0.823 kg/L)

L.C.V = the lower calorific value of fuel, (11000 k.cal/kg)

ηthb = Thermal efficiency of the engine, (35% for Diesel)

427 = Thermo-mechanical equivalent, (kg.m/ k.cal)

ηm = Mechanical efficiency of the engine, (80% for Diesel)

Footprint Calculation

Global warming potential (GWP) of all the tiers is calculated individually using the conversion factors of IPCC (2007) corresponding to a 100-year time horizon. The formula for the calculation of GWP of $tier_i$ (i = 1, 2 or 3) is given by equation (8):

$$GWP(tier_i) = \text{emission/removal of } CH_4 \times 25 + \text{emission/removal of } N_2O \times 298 + \text{emission/ removal of } CO_2 \quad (8)$$

Table 4: Emissions of N_2O and CO_2 from synthetic fertilizers applied on soils for wheat and corn crops

Region	Product (ton)	kg N_2O/ ton harvest	kg CO_2/ ton harvest	ton CO_2eq
Wheat				
Delta	4,812,280	0.38	112.4	540,845
Middle Egypt	1,576,791	0.38	112.4	177,213
Upper Egypt	1,451,801	0.38	112.4	163,166
Outside valley	610,128	0.38	112.4	68,571
Egypt	8,450,999	0.38	112.4	949,796
Corn				
Delta	3,447,527	0.48	144.5	498,166
Middle Egypt	1,774,365	0.48	144.5	256,395
Upper Egypt	1,092,874	0.48	144.5	157,920
Outside valley	240,321	0.48	144.5	34,726
Egypt	6,555,088	0.48	144.5	947,207

Where, GWP is in kg CO_2-e ha^{-1}. Emissions are taken as positive while removal as negative. Values are given in kg ha^{-1}. Carbon footprint is calculated by adding the GWP of all tiers. The final representation of the carbon footprint of agricultural systems can be made as spatial or yield scaled carbon footprints according to the formulae are given below equation (9 &10):

$$CF_s = \sum_{i=1}^{3} [GWP(tier_i)] \quad (9)$$

$$CF_y = \frac{CF_s}{\text{Grain Yield}} \quad (10)$$

Where, CF_s is the spatial carbon footprint. Units are (kg CO_2-e ha^{-1}); CF_y is yield scaled carbon footprint. Units are (kg CO_2-e kg^{-1} yield).

Results and Discussion

Annual N_2O emissions

Annual N_2O emissions from synthetic fertilizers applied on soils

Calculated N_2O emissions from nitrogen fertilization applied on soils for wheat and corn are shown in Table 4. Data shows that the highest CO_2 emissions was found in Delta region followed by middle Egypt for both wheat and corn crops that due to the highest production and cultivation area in both regions. Egypt emissions from nitrogen fertilizers applied on soils for wheat was 0.38 and 0.48 kg N_2O per ton harvest for corn. The CO_2eq emissions from applying synthetic fertilizers on wheat and corn were 112.4 and 144.5 kg CO_2 per ton harvest, respectively. The total CO_2eq emissions from synthetic fertilizers for wheat was 949,796 and 947,207 ton CO_2 for corn.

Mineral N fertilizers are essential to sustain optimum yields that are required to satisfy the increasing global need for food and sustainable production for crops. The emissions (kg N_2O per ton harvest) for corn were higher than wheat because the amount of nitrogen added to the soil for corn was 288 and 190 kg/ha for wheat. This result is in agreement with Asgedom and Kebreab (2011) who reported that increasing N fertilizer application for the sake of providing sufficient quantity of grains to meet the ever-growing population needs has given rise to carbon emissions. Greater consideration of applying the N fertilizer at a suitable rate, proper selection of the N sources, and timing application is highly recommended. Wang et al. (2007) reported that the production and application of nitrogen fertilizers had the largest environmental impact in the winter wheat and corn production system. The maximum emissions of N_2O were recorded in the first few weeks, after the planting of wheat crop

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Table 5: Emissions of N_2O and CO_2 from application of manure on soils for wheat and corn crops

Region	Product (ton)	kg N_2O/ ton harvest	kg CO_2/ ton harvest	ton CO_2eq
Wheat				
Delta	4,812,280	0.26	78.7	378,592
Middle Egypt	1,576,791	0.26	78.7	124,049
Upper Egypt	1,451,801	0.26	78.7	114,216
Outside valley	610,128	0.26	78.7	48,000
Egypt	8,450,999	0.26	78.7	664,857
Corn				
Delta	3,447,527	0.38	112.4	387,463
Middle Egypt	1,774,365	0.38	112.4	199,418
Upper Egypt	1,092,874	0.38	112.4	122,827
Outside valley	240,321	0.38	112.4	27,009
Egypt	6,555,088	0.38	112.4	736,717

and overall maximum emissions of N_2O were recorded from the higher doses of N fertilizer levels, with the exception of 240kg N ha-1, N fertilizer level (Tanveer et al., 2014). Increased greenhouse gas emissions of corn grain due to nitrous oxide emissions from soil were much higher than reductions of greenhouse gas emissions of corn grain due to corn yield and changes in soil organic carbon levels at a higher nitrogen application rate (Kim and Dale, 2008).

Annual N_2O emissions from application of manure on soils

Table 5 shows the estimation of N_2O emissions from manure applied on soils for wheat and corn. The data illustrated that the lowest CO_2 emissions was found in outside valley region followed by upper Egypt for both wheat and corn crops that due to the lowest production area in both regions. Egypt emissions from manure applied on soils for wheat was 0.26 and 0.38 kg N_2O per ton harvest for corn. The CO_2eq emissions due to the use of manure for wheat and corn cultivation were 78.7 and 112.4 kg CO_2 per ton harvest, respectively. The total CO_2eq emissions from manure for wheat was 664,857 and 736,717 ton CO_2 for corn. The emissions (kg N_2O per ton harvest) for corn were higher than wheat because the amount of manure added to the soil for corn was 43 and 28 m3/ha for wheat.

The N_2O emissions were higher in soils with elevated organic matter levels, reflecting greater capacity to mineralize nitrogen and more available carbon for microbial activity as soil organic matter increased the amount of manure added to the soil for corn more than wheat. The storage and handling of manure also contribute to N2O emissions. The rate of nitrification in stored manure depends on the amount of nitrogen and the availability of oxygen necessary for the chemical reaction. Thus, nitrification does not occur in anaerobic processes. Rather, the denitrification of manure, nitrites and nitrates lead to N_2O emissions, even for anaerobic conditions. The mean value for the emission factor per kg of N applied in manure is 3.75 kg CO_2-eq/ kg N, with minimum and maximum values of 1.03 and 11.4 kg CO_2-eq/ kg- N, respectively. Due to the larger volatilization, these values are slightly smaller than for synthetic fertilizers. Manure field application is considered to be the main source of agricultural N_2O since all manure types significantly increase microbial production of N_2O from soils (Crosson et al., 2011).

Annual N_2O emissions from application of crop residues

Calculated N_2O emissions from crop residues for wheat and corn are shown in Table 6. Data shows that the highest CO_2 emissions was found in Delta region followed by middle Egypt for both wheat and corn crops. The average Egypt emissions form crop residues for wheat was 0.12 and 0.15 kg N2O per ton harvest for corn. The CO_2eq

Table 6: Emissions of N_2O and CO_2 from crop residues for wheat and corn crops

Region	Product (ton)	kg N_2O/ ton harvest	kg CO_2/ ton harvest	ton CO_2eq
Wheat				
Delta	4,812,280	0.12	36.6	176,233
Middle Egypt	1,576,791	0.12	36.6	57,744
Upper Egypt	1,451,801	0.12	36.6	53,167
Outside valley	610,128	0.12	36.6	22,344
Egypt	8,450,999	0.12	36.6	309,488
Corn				
Delta	3,447,527	0.15	45.5	156,863
Middle Egypt	1,774,365	0.15	45.5	80,734
Upper Egypt	1,092,874	0.15	45.5	49,726
Outside valley	240,321	0.15	45.5	10,935
Egypt	6,555,088	0.15	45.5	298,258

Table 7 (a): Emissions of CO_2 from operation machinery for wheat and corn crops

Operation	Energy-use hp-hrs/ha	Diesel Fuel (g)/ ha	Diesel Fuel (l)/ ha	CO_2 kg /ha
Wheat				
Chisel plow	40	2.8	10.3	9
land levelling	62.5	4.3	15.9	14
Seed drill	25	1.8	6.6	6
Mower	18	1.3	4.8	4
Thresher	50	3.4	12.9	12
Combine	55	3.8	14.2	13
Total	250.7	17.2	64.6	58
Corn				
Chisel plow	16	2.8	10.3	9
land levelling	25	4.3	15.9	14
Thresher	20	3.4	12.9	12
Total	61	10.5	39.1	35

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Table 7 (b): Emissions of CO_2 from operation machinery for wheat and corn crops

Cities	Area (ha)	Product (ton)	kg CO_2/ ton harvest	ton CO_2
Wheat				
Delta	700,651	4,812,280	8.9	42,829
Middle Egypt	226,689	1,576,791	8.9	14,033
Upper Egypt	221,011	1,451,801	8.9	12,921
Outside valley	108,925	610,128	8.9	5,430
Egypt	1,257,277	8,450,999	8.9	75,214
Corn				
Delta	391,295	3,447,527	13	44,818
Middle Egypt	228,869	1,774,365	13	23,067
Upper Egypt	146,279	1,092,874	13	14,207
Outside valley	28,261	240,321	13	3,124
Egypt	794,704	6,555,088	13	85,216

Table 8: Emissions of CO_2 from irrigation (pump water) for wheat and corn crops

Region	Irrigating m^3/ha	Energy-use PTO hp-hrs/ ha	Fuel g/ha	Fuel l/ ha	CO_2 kg/ha	Kg CO_2/ ton harvest	Ton CO_2
Wheat							
Delta	5,156	40	2.75	10.74	10	1.5	7,007
Middle Egypt	6,123	47	3.25	12.76	11	1.6	2,494
Upper Egypt	8,237	65	4.5	17.16	15	2.3	3,315
Outside valley	4,125	120	8.25	30.9	28	5	3,050
Egypt	23,641	272	19	72	16	2.6	15,865
Corn							
Delta	8,700	67	4.6	17.4	16	1.8	6,261
Middle Egypt	10,380	80	5.5	20.8	19	2.5	4,349
Upper Egypt	11,170	86	6	22.3	20	2.7	2,926
Outside valley	6,960	202	13.9	52.2	47	5.5	1,328
Egypt	37,210	436	30	113	26	3.1	14,863

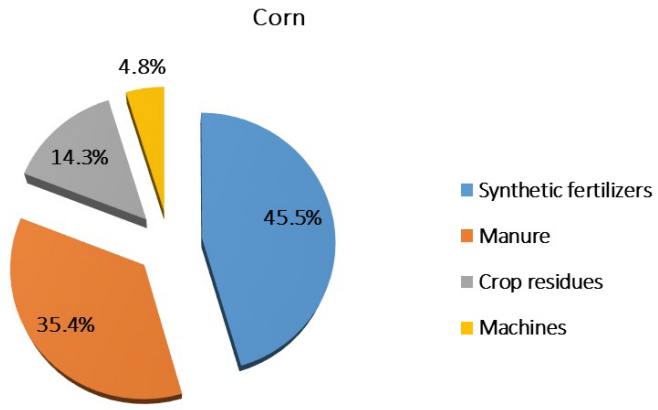

Figure 2: The average percentage of different sources of the GHG resulted from different field practices of corn production in Egypt (Source:from the calculation)

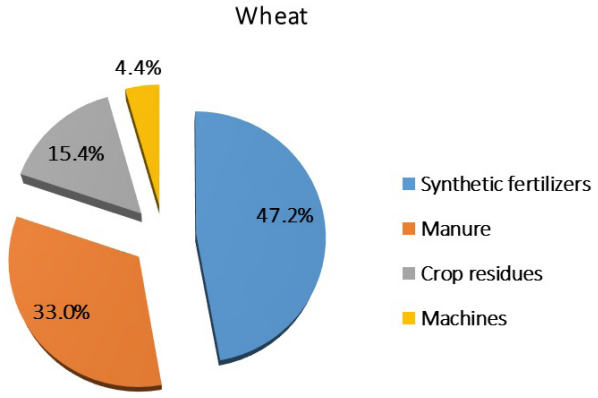

Figure 3: The average percentage of various sources of the GHG resulted from different field practices of wheat production in Egypt (Source: from the calculation)

emissions from crop residues for wheat were 36.6 and 45.5 kg CO_2 per ton for each harvest of corn. Total CO2eq emissions from crop residues for wheat and corn were 309,488 and 298,258 ton CO_2, respectively. Chen et al. (2013) reported that the plant residues with high nitrogen content (low carbon to nitrogen ratio) can speedup mineralization of the plant residues and thus increase nitrate levels in the soil beyond. The residue effects on soil N_2O emissions were positively related to the amounts of residue carbon input as well as residue effects on soil CO_2 respiration. This result is agreed with Gomes et al. (2009) who mentioned that the biochemical composition of plant residues added to the soil is responsible for higher or lower N_2O emissions because the maintenance of straw on the soil surface affects the nitrogen mobilization and immobilization, and consequently, the nitrogen availability in the soil, and also the nitrification and denitrification processes.

Annual CO_2 emissions

Annual CO_2 emissions from farm operation machinery

Farm machinery is important to achieving high yields in arid and semi-arid regions. The calculation of emissions from in seedbed preparation and mechanical operation for wheat and corn are shown in Tables 7A & 7B. Total emissions from using machines in wheat and corn fields were 58 and 35 kg CO2/ha, respectively. The highest CO_2 emissions was found in the land leveling operation (14 CO_2 kg/ha) followed by the harvesting operation, which recorded 12 CO_2 kg /ha Thresher for both wheat and corn.

The emission (kg CO_2/ton harvest) for wheat was 8.9 and 13 for corn. Total CO_2eq emissions from operating machinery for wheat and corn were 75,214 and 85,216 ton CO_2, respectively. These values are in line with research

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Table 9: Emissions of total CO_2eq per hectare, GHG and carbon footprint from wheat and corn

Region	Product (ton)	ton CO_2eq/ ha	ton CO2 GHG	CFP
Wheat				
Delta	4,812,280	1.63	1,143,314	0.238
Middle Egypt	1,576,791	1.65	374,648	0.238
Upper Egypt	1,451,801	1.57	346,683	0.239
Outside valley	610,128	1.36	148,283	0.243
Egypt	8,450,999	1.55	2,012,928	0.239
Corn				
Delta	3,447,527	2.69	1,051,483	0.305
Middle Egypt	1,774,365	2.38	545,215	0.307
Upper Egypt	1,092,874	2.30	336,621	0.308
Outside valley	240,321	2.63	74,293	0.309
Egypt	6,555,088	2.50	2,007,613	0.307

by Frye and Phillips (1981), Bowers (1992), Swanton et al. (1996) and Borin et al. (1997).

Annual CO_2 emissions from irrigation (pump water)

The energy required to pump water depends on numerous factors including total dynamic head. Calculated CO_2 emissions from pumping and lifting water applied to the soils for wheat and corn are shown in Table 8. The common pump used at valley was Indian type 8 hp and outside valley submersible pump was an average of 100 hp. The highest CO_2 emissions were found in the outside valley due to pumping for different lift heights followed by Upper Egypt then Middle Egypt and finally the Delta region for both wheat and corn crops that due to pumping for different lift heights and the climate in different regions. The total Egypt emissions from pumping and lift water applied to the soils for wheat was 15,865 and 14,863 ton for corn. The CO_2 emissions pumping and lifting for wheat was 2.6 and 3.1 kg CO_2/ton harvest for corn. These findings agree with research from Batty and Keller, (1980); Singh et al. (1999); Sloggett (1992) estimated that 23% of the on-farm energy use for crop production in the US was for on-farm pumping.

The contribution of GHG emission sources for wheat and corn

Figures 2 and 3 demonstrate the percentage contributions from the different aspects and field practices for wheat and corn production. Synthetic fertilizer emissions were the main source of emissions contributing to approximately 47.2% for wheat and 45.5% for corn of the total emissions. Manure had the second largest contribution of synthetic fertilizer emissions (33 for wheat and 35.4% for corn), while the machinery activities contributed to about 4.4% for wheat and 4.8% for corn. Moreover, crop residues contributed approximately 15.4% for wheat and 14.3% for corn of the total GHGs.

This result is agreed with Al-Mansour and Jejcic (2014) who reported that the share of GHG emissions from the fertilizers used represents 42-76% of the total emissions from crop production. The carbon footprint (CF) was augmented with increasing the rate of nitrogen, except for net energy yield (NEY). The treatment of N 225 kg/ha had the highest grain yield (10 364.7 kg/ha) and NEY (6.8%), however the CF (0.25) was lower than that of N 300 kg/ha, which indicated that the rate of 225 kg N/ha can be optimal for summer corn in NCP (Wang et al.,

2015).

The CO_2eq emission and carbon footprint

The calculation of total CO_2 emissions per hectare, total greenhouse gas emission (GHG), and carbon footprint for wheat and corn are shown in Table 9. Data illustrated that the lowest CO_2 emissions per hectare were found in outside valley region followed by Upper Egypt for wheat. Still, corn had the highest CO_2 emissions per hectare in the Delta region followed by outside valley. The Egypt CO_2 emissions per hectare of wheat was 1.55 and 2.50 ton CO_2/ha for corn. In Egypt, total greenhouse gas emission for wheat and corn were 2,012,928 and 2,007,613 tonnes, respectively. The carbon footprint for wheat was 0.239 and 0.307 for corn.

Increasing awareness of climate change and energy security is spurring greater investigation into how the sustainability of farming systems can be better managed to produce high-quality and affordable food in sufficient quantities while minimizing potential negative impacts on the environment. The carbon footprint of agricultural products is heavily dependent on the use of fertilizers, while productivity depends on the amount of product produced per unit of land area (Al-Mansour and Jejcic, 2016). In general, wheat had a carbon footprint value of 0.20 kg CO_2eq per kg of grain on a production level of 3.5 t/ha (Gan et al., 2012). The carbon footprint of grain production in China is based on life cycle analysis. Corn had the lowest carbon footprint, i.e., 4052 kg ce/ha of carbon per unit area or 0.48 kg ce/kg per unit yield. The carbon footprint of wheat was 5455 kg ce/ha per unit area or 0.75 kg ce/kg per unit yield (Zhang et al., 2017).

Analyzing food policy and crop production systems at the local level is critical to agricultural climate change planning to identify key influencing policies that will directly or indirectly affect CO_2 emissions and mitigation strategies (Smith et al., 2007).

Conclusions

Agricultural and rural development policies that help diversify income and employment opportunities for the poor and food insecure need to be complemented by policies that address the carbon footprint of entire crop production systems. The carbon footprint is one of the key indicators for assessing the sustainability of production in agriculture and food policy systems. The GHG emissions from the synthetic fertilizers used in all types of farming had a very high impact on the carbon footprint of grain for both crops wheat and corn. The share of GHG emissions from using the synthetic fertilizers represented 47.2 and 45.5% of the total emissions from wheat and corn cultivation. Under Egyptian condition the carbon footprint for wheat and corn was 0.239, 0.307 kg CO_2eq per kilogram of grain. An increase in productivity and optimization of nitrogen fertilizer in production will have a positive influence on decreasing the carbon footprint of agricultural products. There is a need for more studies focused on the carbon footprint of different crops under Egyptian growing conditions.

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Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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Dietary habits and nutritional status among school children in rural and urban areas: A comparative study from Bogor, Indonesia

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Abstract

When Indonesia was combating child undernutrition, overnutrition emerged which made the situation more complex. In fact, dwelling area like rural versus urban is one of the direct determinants which play a big role in shaping dietary habits and nutritional status in population. However, there is a lack of data that shows dieteray habits between urban and rural areas in Indonesia. This study aims to compare the dietary habits and nutritional status between children living in urban and rural areas in Bogor. This study was conducted using the cross sectional method with 77 urban and 65 rural children aged 9-12 years old in Bogor. Nutritional status was assessed by anthropometric measurements, i.e height for age Z-score and IMT for age Z-score. Dietary habit data were obtained by interviewing subjects using validated questionnaire and 3x24 hours food recall. The results showed that urban children had greater risk of being overweight and children living in rural areas had higher risk of being stunted. Children in urban areas showed better dietary habits indicated by greater number of children with regular consumption of breakfast, meat, dairy, and fruits. In conclusion, each area in Bogor showed different malnutrition issue, where higher incident stunting was found in rural area and higher incident of overweight was found in urban area. Therefore, different intervention seems urgent to be elaborated to alleviate the dual malnutrition among children.

Introduction

NCD-Risc (2018) reported that from 1975 until 2016 worldwide children obesity had increased significantly from 0.9% to 7.8% for girls and 0.7% to 5.6% for boys. Unfortunately, the decline of underweight children was lower than the escalated obesity. On the other hand, de Onis and Branca (2016) showed that stunting was the most prevalent of malnutrition in children. These facts indicated that the world has to deal with double burden malnutrition. World Health Organization (WHO, 2016) defines malnutrition as the existence of both undernutrition and overnutrition issues in one individual, household, or population. The low and middle income countries experience this double burden of malnutrition. In Argentina and Vietnam, stunting and underweight children are highly found in rural area and overweight children highly appeared in urban area (Garazza et al., 2016; Le Nguyen et al., 2013).

Indonesian Ministry of Health (IMH, 2013) reported prevalence of stunting among children aged 5-12 years old in Indonesia were 30.7% (IMH, 2013). This number had not changed so much compared to numbers in 2010

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and 2007 (IMH, 2007; IMH, 2010). This undernutrition issue was also experienced by other developing countries (Best et al., 2010). Indonesia decided to join on Scaling Up Nutrition Movement program and release the First 1000 Day of Life Movement to alleviate children undernourishment, in particular stunting and wasting (MCAI, n.d.). However, 18.8% of Indonesian children continued living with an overnutrition issue (IMH, 2013).

Stunting illustrates childrens' welfare and reflects childrens' failure to fulfill linear growth potential (de Onis & Branca 2013). Compared to the average child, children with under and over nutrition tend to have lower physical fitness, school performance, and brain function (Armstrong et al., 2016; Hjorth et al., 2016; Palupi et al., 2013). Overweight children are at greater risk of being overweight adults (Singh et al., 2008). They will have a higher probability of suffering from non-communicable diseases, for instance cardiovascular disease, type II diabetes mellitus, stroke, and hypertension (Reilly & Kelly, 2011). For that reason, children with malnutrition are predisposed to have low work productivity, hence enduring great economic loss (Duijvenbode et al., 2009; McGovern et al., 2017).

Consumption patterns as a direct determinant of nutrition is likely to be influenced by discrepancies of demography situation between urban and rural areas. The main reasons for this gap are the socioeconomic disparities between these areas, for instance income, occupation, and education levels (Sicular et al., 2007). The condition of ecology between these areas also plays a big role in shaping food consumption patterns in society. Thus, those populations are very likely to have different options of food groups which then might influence their consumption patterns (Dean & Sharkey, 2010; Fahlman et al., 2010). As an illustration, it was reported in India that urban community showed higher consumption of fruit and vegetable compared with rural community (Bowen et al., 2011; Yadav & Krishnan, 2008). In China, the higher rate of macronutrient consumption was represented in urban setting than in rural setting (Zhang et al., 2017).

However, there were still few evidences that were available in Indonesia about discrepancy of dietary habits and nutritional status between rural and urban school children. We hypothesised that there were differences of dietary pattern and nutritional status between urban and rural school children. The purpose of the study was to provide data of dietary habits with under and over nutrition incidence of school children in rural- and urban areas as a comparative study from Bogor, Indonesia. The results of the study were expected to support the formulation of effective solutions for alleviating children malnutrition.

Methods

The study used a cross-sectional method that compares dietary patterns and the nutritional status of school children from urban and rural area. One school from each area was selected using purposive sampling. We had conducted preliminary study prior to the main study. The observation on schools in each sub-district were conducted as the preliminary study. Pamijahan sub-district and Bogor Tengah sub-district were chosen as rural and urban area representation, respectively. Those areas were preferred as study location because they reflected urban and rural condition. Bogor Tengah sub-district as urban area was surrounded by many public places, had high density community, and set up as center of Bogor city. Pamijahan sub-district as rural area had low density community and was dominated by agricultural workers inhabitant. These descriptions of rural and urban area representative was according to Act No. 26 Year 2007 about Spatial Planning of Indonesia. Those two areas were 30 km separated. The study was conducted in April until May 2018 and had received approval from ethical clearance comittee of Bogor Agricultural University.#

The minimum subjects were obtained based on formula by Lemeshow et al. (1990).

$$n = \frac{Z^2_{1-\alpha/2} P(1-P) N}{d^2(N-1) + Z^2_{1-\alpha/2} P(1-P)} \quad (1)$$

The confidence (Z) was 95% and the power (d) was 10%. The proportion of students with BMI for age Z-score (BAZ) <-2 and >2 (P) in West Java was 27.7% (IMH, 2013). The student population in rural and urban school (N) were 209 and 313, respectively. In the end, minimum subjects that were needed to be fulfilled were 62 and 69 students from rural- and urban-area, respectively. The minimum subjects were 29.7% and 22.0% of total student population in rural and urban areas

Subjects that participated in the study were school children from 2 classes from each school, which were 4th and 5th grade students. They were chosen since they had better ability to communicate compared to the lower grader. In urban area, only 5th grade students participated because the 4th grade students had different study time sequence. The 6th grade students were excluded because they had to get intensive learning for national examination preparation. The classes were randomly

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Figure 1: A rural school in Bogor, Indonesia (Photo credits: Authors)

selected and all students in those classes participated in the study. In the end, there were 142 students that were eligible to follow and complete all the procedure consisting of 65 students from rural area and 77 students from urban area.

Data of dietary habits consisted of energy and macronutrient intake, adequacy of energy and macronutrient intake, and food consumption. Nutritional status data consisted of height and BMI measurement.

Energy and macronutrient intake

Data were obtained using 3x24 hours food recall interview to the subjects. The subjects were asked about what they consumed in the day before, started from waking up until going to sleep. For the veracity of the food size that were consumed, interviewer used food photo book in a digital form. This book was released by Indonesian Ministry of Health (IMH, 2014). The students were interviewed in 3 time phases of a month, which were in the beginning, middle, and the end of the month. This study also analysed the energy and macronutrient intake from breakfast and snack. Meal before 9 a.m. was considered as breakfast while the snack occasion was any consumption activities between the meals.

Adequacy of energy and macronutrient intake

The adequacy of subjects' intake were analysed by comparing total daily intake with individual requirement. Adequacy of energy and macronutrient intake from breakfast and snack occasions were calculated by comparing intake from breakfast and snack with individual requirement. Individual requirement was calculated by using estimated energy requirement formula (Institute of Medicine, 2005). Age, sex, height, and weight of each subjects became the consideration of the formula. Subjects were categorized adequate for achieving 90-110% individual requirement for total daily intake. Adequate breakfast and snack intake were achieved by meeting 15-30% and <15% individual requirement, respectively.

Food consumption

Data of food consumption were measured by interviewing the subjects using validated questionnaire. Subjects were asked how often they eat breakfast, snack, and food groups in the past week. Food groups that were asked consisted of sugar sweetened beverage, fast food, fruit, vegetable, meat, poultry, seafood, egg, dairy, and legume. Regular consumption was indicated by eating breakfast, snack, and food groups five times per week or more.

Nutritional status

Nutritional status data were obtained by direct measurement included body height and weight. The heights of the subjects were measured using microtoise with 0.1 cm accuracy and 2 meters of measurement capacity. Digital scale with 0.1 kg accuracy and 170 kg capacity was used to measure weight of the subjects. Before the measurements were conducted, subjects were asked to remove their shoes, socks, watch, and belt. Nutritional status of the subjects were categorized as stunting if height for age Z-score <-2.0. Meanwhile, overweight/obese children were defined as BAZ > 2.0. WHO Anthrop

Table 1: Subject distribution based on sex and age

	Urban	Rural
Sex		
Boys	32 (41.6%)	34 (52.3%)
Girls	45 (58.4%)	31 (47.7%)
Age		
9	0 (0.0)	8 (12.3%)
10	31 (39.3%)	26 (40.0%)
11	46 (58.2%)	25 (38.5%)
12	2 (2.5%)	6 (9.2%)
Total	77 (100%)	65 (100%)

Plus was applicated to calculate the Z-score of height for age and BMI for age. All data collection were conducted by trained enumerators who were qualified to do interview and anthropometric measurement.

Data analysis

Energy and nutrient intake was examined by Nutrisurvey 2007 that was completed by Indonesian food databases. Food commodities that were not available on the database were added to the software. For ready-to-eat foods, nutritional value of the foods were recorded from its food label. For self made foods, the nutritional value were obtained by inputing the recipe to the software.

Independent t-test analysis was used to examine the mean difference of nutrient intake, and Z-score of HAZ (Height for Age Z-score) and BAZ between children living in urban- and rural-areas. Chi square analysis was used to examine adequacy level of nutrient intake, food consumption, and nutritional status betweeen urban and rural children. Correlation siginificance was confirmed as p-value was below 0.05. All data analysis were done using SPSS 20.0.

Results

Distribution of the subjects based on sex and age was presented in Table 1. There were 77 (54.2%) students living in urban areas. A higher number of boys was presented in rural areas, while there were a greater number of female students in urban areas. However, the number of 9 years old students was only demonstrated in rural areas because there were no 4th grade students that participated in urban area.

Table 2 reports that there were significant differences of HAZ and BAZ between urban and rural children groups. Rural groups had significantly lower HAZ than the urban one. Similar trends were also shown from the BAZ indicator. Rural groups had significantly lower BAZ compared to urban groups. Stunting was largely shown in rural areas, while overweight was highly demonstrated in urban areas (Table 3). Nonetheless, there were 33.8% of stunted children in rural areas, where more than one-third of them were severely stunted. Along with the high percentage of overweight of urban students, there were urban students that still suffered from being underweight. The total intake and adequacy of total daily, breakfast, and snacks are given in table 2. Regarding total daily energy and macronutrient intake, all indicators appeared to be significantly different. Urban groups had significantly higher total intake of energy, protein, fat, and carbohydrate. Breakfast contributs significantly to higher protein intake for urban groups compared to rural groups, while snacks contributs significantly higher protein and fat intake for urban groups compared to rural areas.

Both groups showes protein intake that was below recommendation (<90%) and fat intake that is above the recommendation (>110%). All nutrient contribution from breakfast occures in both areas presented above 15% where the recommendation was addressed.

By categorizing the adequacy level of total daily, breakfast, and snack intake, Table 4 showes the percentage of students who fulfilled the recommendation from total daily, breakfast, and snack intake. The number shown below presents the number of students that consumes adequate energy and macronutrient in each occasion. Students with adequate total daily intake of energy and

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Table 2: Mean value of HAZ, BAZ, intake, and adequacy of energy and macronutrient from total-, breakfast-, and snack-intake

Indicators (unit)	Urban		Rural		Total		P-value
HAZ	-0.28±1.2		-1.60±0.97		-0.90±1.29		0.000*
BAZ		0.31±1.61		-0.28±1.07		0.03±1.42	0.010*
Total Daily	Intake	Adequacy (%)	Intake	Adequacy (%)	Intake	Adequacy (%)	
Energy (k cal)	1815.57±63.03	96.42±36.05	1365.80±47.20	87.18±24.92	1568.3±43.5	92.19±31.69	0.000*
Protein (g)	58.33±2.08	71.06±27.30	36.18±1.53	52.35±17.99	44.9±1.6	62.49±25.22	0.000*
Fat (g)	64.29±2.93	143.34±63.27	46.49±2.23	117.85±46.14	52.1±2.1	131.67±57.33	0.000*
Carbohydrate (g)	231.26±8.96	93.63±36.16	207.15±6.84	92.91±26.16	215.1±5.9	93.30±31.87	0.009*
Breakfast	Intake	Adequacy (%)	Intake	Adequacy (%)	Intake	Adequacy (%)	
Energy (kcal)	425.33±20.94	23.86±9.66	454.13±16.25	26.75±8.46	432.10±13.24	25.17±9.21	0.609
Protein (g)	14.38±0.62	17.57±6.42	11.05±0.59	16.31±7.06	12.25±0.44	17.00±6.72	0.000*
Fat (g)	13.65±1.44	36.32±25.05	16.48±1.15	42.73±22.97	14.03±0.90	39.23±24.26	0.614
Carbohydrate (g)	57.86±2.62	22.73±9.17	56.83±2.31	25.75±8.39	56.98±1.76	24.10±8.92	0.539
Snack	Intake	Adequacy (%)	Intake	Adequacy (%)	Intake	Adequacy (%)	
Energy (k cal)	478.10±33.33	27.55±18.02	373.22±2.74	25.13±8.39	396.65±21.37	26.45±15.46	0.144
Protein (g)	11.62±0.87	15.51±10.53	6.43±0.67	10.96±7.74	8.30±0.60	13.43±9.60	0.000*
Fat (g)	16.61±1.23	40.69±27.29	11.88±0.93	31.38±19.21	13.33±0.84	36.43±24.30	0.001*
Carbohydrate (g)	62.20±5.41	28.97±20.60	60.15±3.74	29.64±13.87	60.10±3.41	29.28±17.78	0.885

* p-Value < 0.05 means significant difference of intake between area

Adequacy was obtained by comparing intake with individual requirement in each nutrient

protein are significantly higher in urban areas. Regarding the breakfast occasion, there were more students in rural areas who consumed adequate energy. For snacks, there are more students in rural areas whose consumption exceeds the recommended carbohydrate intake levels. Table 5 showed the differences of dietary habits between urban and rural students. It is apparant that students living in urban area had higher chance to consume breakfast, meat, dairy, and fruit regularly.

Discussion

The purpose of this study is to analyze the difference between dietary habit and under- and over-nutrition incidences of urban and rural school children. The result provides new confirmation of double burden malnutrition that is occured in Bogor, West Java, Indonesia. This study supported the data that stunted children were highly found in rural areas compared to urban areas, like previous studies had documented either in Indonesia (Mahmudiono et al., 2017; Rachmi et al., 2016) or worldwide (Nabag 2011; Cesani et al., 2013). Overall, stunting prevalence (19.0%) was lower compared with the national number (30.7%), despite rural stundents showed higher percentage of stunting than the national number (IMH, 2013). Numerous studies examined some correlation between environmental factors and stunting incidence in rural areas, namely parental education, family

Table 3: Differences of nutritional status based on HAZ and BAZ between urban- and rural-area

Indicators (%)	Urban	Rural	Total	OR
HAZ				
Severely stunting	0.0	9.2	4.2	N/A
Stunting	6.5	24.6	14.8	5.348*
Normal	93.5	66.2	81.0	1
BAZ				
Severe thinnes	2.6	0.0	1.4	N/A
Thinnes	3.9	4.6	4.2	1.109
Normal	71.4	93.8	81.7	1
Overweight	22.1	1.5	12.7	18.868*
Obesity	0.0	0.0	0.0	N/A

* p-Value < 0.05 means significant difference of intake between area
OR that was shown compared with normal group

income, and food access (Quansah et al., 2016; Tessier et al., 2008; Muthuri et al., 2014). Moreover, this study confirmed that the overweight issue was appeared to be higher in urban children, same as what happened in other developing countries (Chen et al., 2011; Le Nguyen et al., 2013).

Act No. 26 Year 2007 about Spatial Planning of Indonesia stated that rural area in Indonesia were characterized by domination of agriculture activity among the habitants. The food environments of rural and urban areas might be different because of their demographic, occupation, and sociology (Ratcliffe et al., 2016; Kennedy et al., 2009; Dean & Sharkey, 2010). Tessier et al. (2008) reported that availability of supermarket as diverse food source were higher in urban area. This condition may lead to the consumption of more diverse food and resulting in better food pattern. But along with supermarket, there were also more fast food restaurants, corner stores, and convinience stores found in urban school area. These stores provided higher chance for urban students to consume foods that were sold by those stores (Martinez-Donate et al. 2016; Monge-Rojas et al. 2013). Other than that, many foods were more easily accessed by urban residents because of the affordability. Family with lower income appeared to have lower consumption of fruit and vegetable because they needed to spare more money to buy fruit and vegetables (Miller et al. 2016). A study case conducted in West Java showed that the marketing of vegetable commodities consisted of many levels of distributor. The marketing was started from farmers, collectors, groceries, market scalpers, wholesalers, and ended up with retailers that traded to the consumers. This multilevel network of marketing explained why vegetable commodities could be difficult to afford for rural residents, although most of them worked as the major actor of vegetable producer. There were only few farmers that sold the products directly to consumers (Permana et al., 2006).

Students were at an age where their dietary patterns were highly influenced by school food environment. For that reason, school acted a significant role to shape eating habits of students (Briefel et al., 2009). From 1997 until 2006, school children presented an increasing trend of calorie intake that was contributed from fast food (Poti & Popkin, 2011). Furthermore, students tended to have lower intake of fruit and vegetable that started from 1st grade and became worse in adolescent time (Albani et al., 2017). The differences of dietary patterns between urban and rural areas had been recorded in numerous studies. Differences of breakfast habits between urban and rural children that was presented in this study had been reported inversely compared to studies in Australia (Bolton et al., 2016), Scotland (Levin, 2013), and Iran (Maddah, 2008). Their studies showed that urban children had higher chance to have breakfast regularly. The attitude of students' parents might confirm why this study

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Table 4: Prevalence of stunting, overweight, and adequacy level of energy and nutrient from total daily-, breakfast-, and snack-intake between urban- and rural-area

Indicators (unit)		Urban		Rural		Total		OR
	Stunting	5	6.5	22	33.8		19.3	7.353*
	Over-weight	17	22.1	1	1.5		12.5	18.133*
Total intake								
Energy	Deficient	41	53.2	56	86.2	97	68.3	0.209*
	Normal	28	36.4	8	12.3	36	25.4	1
	Exceed	8	10.4	1	1.5	9	6.3	0.438
Protein	Deficient	30	39.0	57	87.7	87	61.3	0.123*
	Normal	30	39.0	7	10.8	37	26.1	1
	Exceed	17	22.1	1	1.5	18	12.7	0.252
Fat	Deficient	37	48.1	49	75.4	86	60.6	0.529
	Normal	20	26.0	14	21.5	34	23.9	1
	Exceed	20	26.0	2	3.1	22	15.5	0.143*
Carbohy-drate	Deficient	48	62.3	52	80.0	100	70.4	0.484
	Normal	21	27.3	11	16.9	32	22.5	1
	Exceed	8	10.4	2	3.1	10	7.0	0.477
Breakfast intake								
Energy	Inadequate	19	25.0	3	4.8	22	15.8	6.667*
	Adequate	57	75.0	60	95.2	117	84.2	
Protein	Inadequate	12	15.8	5	7.9	17	12.2	1.175
	Adequate	64	84.2	58	92.1	122	87.8	
Fat	Inadequate	28	36.8	8	12.7	36	25.9	4.010*
	Adequate	48	63.2	55	87.3	103	74.1	
Carbohy-drate	Inadequate	21	27.6	9	14.3	30	21.6	2.291
	Adequate	55	72.4	54	85.7	109	78.4	
Snack intake								
Energy	Adequate	15	19.5	4	6.2	19	13.4	3.690*
	Exceed	62	80.5	61	93.8	123	86.6	
Protein	Adequate	24	31.2	21	32.3	45	31.7	0.949
	Exceed	53	68.8	44	67.7	97	68.3	
Fat	Adequate	14	18.2	13	20.0	27	19.0	0.889
	Exceed	63	81.8	52	80.0	115	81.0	
Carbohy-drate	Adequate	14	18.2	3	4.6	17	12.0	4.593*
	Exceed	63	81.8	62	95.4	125	88.0	

*p-value < 0.05, means significant difference between area
For total daily intake, *p-value < 0.05 means significant difference between area compared with normal group
Total daily intake categorized as adequate group for fulfilling 90-110% individual requirement. Adequacy below 90% is categorized as deficient and above 110% is categorized as exceed
Breakfast intake was categorized as adequate for fulfilling 15% or more of individual requirement
Snack intake was categorized as adequate for fulling 15% or less of individual requirement

Table 5: Difference of student number consuming frequently food group selected between two areas

Variable		Urban		Rural		Total		Odd Ratio	P-Value
		n	%	n	%	N	%		
Breakfast	< 4x/week	9	11.7	27	41.5	36	25.4	0.186	0.000
	> 4x/week	68	88.3	38	58.5	106	74.6		
Snacking	< 4x/week	48	62.3	35	53.8	83	58.5	1.419	0.393
	> 4x/week	29	37.7	30	46.2	59	41.5		
Fast Food	< 4x/week	72	93.5	64	98.5	136	95.8	0.026	0.297
	> 4x/week	5	6.5	1	1.5	6	4.2		
SSB	< 4x/week	63	81.8	49	75.4	112	78.9	1.469	0.411
	> 4x/week	14	18.2	16	24.6	30	21.1		
Vegetable	< 4x/week	50	64.9	49	75.4	99	69.7	0.605	0.202
	> 4x/week	27	35.1	16	24.6	43	30.3		
Fruit	< 4x/week	56	72.7	58	89.2	114	80.3	0.322	0.019
	> 4x/week	21	27.3	7	10.8	28	19.7		
Meat	< 4x/week	71	92.2	65	100	136	95.8	N/A	0.031
	> 4x/week	6	7.8	0	0.0	6	4.2		
Poultry	< 4x/week	63	81.8	60	92.3	123	86.6	0.375	0.085
	> 4x/week	14	18.2	5	7.7	19	13.4		
Seafood	< 4x/week	73	94.8	61	93.8	134	94.4	1.197	1.000
	> 4x/week	4	5.2	4	6.2	8	5.6		
Egg	< 4x/week	58	75.3	52	80.0	110	77.5	0.763	0.550
	> 4x/week	19	24.7	13	20.0	32	22.5		
Dairy	< 4x/week	27	35.1	53	81.5	80	56.3	0.122	0.000
	> 4x/week	50	64.9	12	18.5	62	43.7		
Legumes	< 4x/week	63	81.8	50	76.9	113	79.6	1.350	0.534
	> 4x/week	14	18.2	15	23.1	29	20.4		

*p-value < 0.05, means significant difference between area
SSB is sugar sweetened beverage
N/A is not available

showed different results from other studies. Parents of rural children didn't have strong attitude that breakfast was important for children. The similar results with other studies were mostly showed by intake of animal source foods that were significantly higher consumed by urban children (He et al., 2013; Itoi et al., 2012, Herrador et al., 2016). However, in this study, only consumption of meat and dairy that showed the differences significantly. Different from animal based food, plant based food were consumed highly in rural children (Herrador et al., 2016). Total Diet Study in Indonesia (IMH, 2014) revealed that more plant based protein foods were consumed compared with animal based protein foods.

Dietary intake as one of direct determinants of nutritional status were intensely explored among researchers.

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Beyond energy intake, protein intake was investigated deeply on how it's associated with stunting incidence in children. It were ranging from energy and protein intake, adequacy, and consumption protein source foods, for instance milk and meat (Iannotti & Lesorogol, 2014; Sekiyama et al., 2012; Mwaniki & Makhoka, 2013, Berg et al., 2018). Regarding the relationship between intake with area setting, this study presents the lower intake of energy and nutrient in rural area students. These findings are similar with other studies that reveal the higher intake of energy and macronutrient in urban children (Zhang et al., 2017; Liu et al., 2008). Concerning overweight incidence in school age children, Fidler Mis et al. (2017) showed how sugar sweetened beverage caused obesity in children by increasing BMI and waist circumference. Fast food as a popular dish among students also contribute to overweight incidence in children for its high calorie density. More frequent fast food consumption is associated with higher risk of being overweight (Braithwaite et al., 2014).

Dietary habits and nutritional status of school children might be highly influenced by school food environment. Besides teacher, street food vendors that are available in schools affect students' behaviour on snack consumtption. Manulu and Su'udi (2016) conducted a review study about monitoring policy for improving food safety on street vendors. It was reported that the policies to create socialization programs were sufficient, but the implementation was not well coordinated among authorities. Furthermore, the availability of a school canteen which provides healthy and hygiene foods need to be emphasized. The school canteen that is supervised by school accomodates students to consume healthy food.

Conclusion and Recommendations

In summary, this study confirmed the hypothesis that school children from different environment showed different dietary habits and nutritional status. The stunting incidence was significantly higher in rural area and overweight was higher in urban area. Other than that, total daily intake of energy was higher in urban area. Dietary habits of urban children were better that were indicated by higher chance to have regular breakfast and consumption of fruit, dairy, and meat. This evidence might be led by environmental condition that was shaped by family income, education, and cultural believe. A comprehensive policies need to be implied in each dwelling area as students have different dietary patterns, especially in school environment where education process are mostly taken. Teachers as the major educator in school play important role to relay the information about nutrition. Nutrition intervention is not only required for students, but also parents as the main nutrition provider.

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Conflict of Interests

The authors hereby declare that there is no conflict of interests.

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Peasant Rights are Human Rights!

Photo credit: viacampesina.org

The United Nations General Assembly has adopted the Declaration of Peasant Rights and People living in Rural Areas. On December 17, 2018, the 73rd Session of the UN General Assembly took the final vote, strengthening the rights of small-scale farmers and rural communities in unprecedented ways. The declaration was adopted with 121 votes in favor, 8 votes against and 54 abstentions and now represents a legal instrument for the implementation of peasant rights on the national level. According to the declaration: **States shall respect, protect and fulfill the rights of peasants and other people working in rural areas.**

The long way up to this decision started by the international peasant movement La Via Campesina and its allies, such as FIAN, CETIM or Farmers Association of Schwäbisch Hall. In 2018, several decisive steps had been taken up to the successful adaptation; the text had been finalized at the 5th Open-ended Intergovernmental Working Group of the Human Rights Council (HRC). The declaration is seen as a crucial to the struggle for a dignified live of rural people and small-scale producers.

Source: Foundation House of Farmers, Schwäbisch Hall/ Farmers Association of Schwäbisch Hall, Germany.
Further Information: *http://www.global-peasants-rights.com*

The 7th German Sensory day in Hamburg

Die Deutsche Gesellschaft für Sensorik (DGSens) is a non-profit association comprising of 230 members from industry, universities and institutions that are interested in sensory evaluation in Germany. Their vision is to promote research in sensory science and encourage further developments of sensory analysis and consumer research in Germany. Since 2012, DGSens has been organizing an outstanding annual symposium under the title of "German Sensory Day; Deutsche Sensoriktage". Although this event is at the national level, it has been achieving great interest in Germany, Austria and Switzerland during the last seven years.

This year, DGSens has organized their 7th meeting in Hamburg on 25th-26th October with approx. 100 participants from industry and research field. The event was organized by the board of DGSens: Dr. Dirk Minkner (Chairman), Thomas Krahl, Dr. Ing. Andrea Maaßen, Prof. Dr. Guido Ritter, Prof. Dr. Andreas Scharf.

The DGSens symposium provided a platform for students, specialists, experts, as well as managers to introduce information on new technologies and developments in sensory evaluation, neuroscience, consumers' psychology and behavior, health, and Chemosensory. The event started with a workshop which held very insightful and interesting lectures put together by experienced sensory experts on different aspects, including as Sensory Reporting & Com-

munication, SWOT Analysis, among many others.

Photo credit:www.dgsens.de

During the second day, DGSens gave young scientists the opportunity to present their research projects and innovative ideas as an oral presentation and posters. At the end of the 7th Deutsche Sensoriktage, three of the best young researchers' presentations were honoured and awarded the "Urkunde für hervorragende leistung " with a certificate and trophy. The three young researchers awarded are: Diana Ismael: "Investigating the differences in consumers' emotions towards organic and conventional food: A study of a cognitive survey and sensory evaluation"; Tarek Butt: "Vergleich der sensorischen Produkträume von geschulten Prüfpersonen und Konsumenten durch External Preference Mapping und CATA-Methode"; Fabian Westen: "The Sense".

A Heath Magic Tool or an Environment Monster? "Gene Drives": An in-prospect technology that may defeat malaria

Photo credit: ljoão P. Burini (flickr)

The U.N. conference on biodiversity in the Egyptian city of Sharm el-Sheikh provided a platform to discuss at length the gene-drive technology as a new technology to defeat malaria. Gene-drive is based on genetic engineering and aims at modifying genes of certain species.

In 2017, more than 200 million people around the planet suffered from malaria. According to the Gates Foundation, most of them were children in Africa. The Bill and Melinda Gates Foundation has launched a program called Target Malaria. This program uses the gene-drive technology to genetically modify malaria-carrying mosquitoes to reduce the spread of this disease. One example of the application of these genetical modifications is to produce infertile offspring from the engineered mosquitoes.

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The gene-driven method has always been a broad, controversial topic within the science world, even though its advocates cannot provide guarantees that this tool is ready to be applied safely in the environment. During the Conference of the Parties, there has been a prolonged debate between opponents and advocates of gene-diver technology. Opponents described the gene-diver as a '' slippery business" that may cause harm to the ecological systems and even to the indigenous cultures. They called for a moratorium on the gene-drive field experiments. Jim Thomas, who is one of the opponents and a supporter of the moratorium, emphasized the importance of obtaining consent from people who may be affected by the application of the gene-drive technology field experiment. Similarly, Mariann Bassey-Orovwuje, chair of the Alliance for Food Sovereignty in Africa declared that: "In Africa, we are all potentially affected, and we do not want to be lab rats for this exterminator technology."

On the contrary, advocates defend gene-driver technology and explained that it is not a magic solution, but rather a complementary tool. According to Kevin Esvelt, a molecular biologist at MIT and a pioneer of gene-drive, it is "better that we use DNA than potentially inhumane pesticides." Moreover, the gene-drive was also supported by representatives of some African nations. They declared that leaders of the African Union encourage this technology, accept its benefits, and understand that no new technology goes without risk.

After two weeks of extended discussion, it was approved that gene-drive will continue with its tests, however under stricter controls. The decision underlined the importance of confirming that the application of re-engineered organisms demonstrates no hazards. In addition, it was decided to restrict any field work with the requirement of obtaining a "free, prior and informed consent" of the population who may be affected by the trials. Though, the form of the consent was not defined. However, the results of the discussions were a relief for gene-driver supporters who came out safely without moratorium or any other restriction that prevent the program from going forward.

Report

Mediterranean Youth for Water Network (MedYWat): Connecting the youth from the MED

Francisco Pedrero[1], Faissal Aziz[2], Hussam Hussein[3]

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WWD2018 in Anafora (Egypt), face to face MedYWAt meeting

Water scarcity is one of the major problems facing the Mediterranean region (MED region), and climate change is putting an additional pressure on the already limited water resources. In the Southern MED region, 65% of the population is concentrated in coastal hydrological basins and environmental pressures on water resources are constantly increasing. A common problem of aquifers in the MED region is groundwater depletion and quality degradation due to multiple stresses, especially extractions for the agricultural sector.

In the agricultural sector, which is the MED region's biggest water user, large volumes of water are wasted due to inappropriate techniques or outdated infrastructure. One important reason is that the MED region has some of the world's lowest water service fees for irrigation, enabling farmers to grow water-intensive crops and to reduce incentives for efficient irrigation technologies.

Arable land is being reduced by advancing urbanization, erosion, salinization and desertification of soils, much of it stemming from unsustainable agricultural practices. If existing rates of land degradation continue, by 2020 another 8.3 million hectares of agriculture land may be lost, versus the situation in 1960. To avoid a water crisis, many countries must conserve water resources, manage supply and demand, and reduce water pollution, as well as the environmental impacts of growing population. Considering all previous challenges and the awareness of the role youth can play in MED region, the Mediterranean Youth for Water network (MedYWat) was created.

The Mediterranean Youth for Water network (MedYWat) is supported by the Center for Mediterannean Integration (Marseille, France) and emcompasses over 80 young Mediterranean water researchers, entrepreneurs and activ-

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ists working on water challenges in the region. This network was launched during the first World Water Day youth workshop on treated wastewater reuse (Marseille, March 2017). The group's motto is "Empowering, Connecting & Change-Making". Its' values are inclusiveness, innovation and a collaborative spirit. Members consider water as a critical public good in the region and are determined to positively impact the fragile water situation of the Mediterranean region, while connecting with other young water networks around the world to amplify the voice of youth on the regional and global water and environmental agendas.

The MedYWat vision is a Mediterranean Region where youth is a recognized, active stakeholder at all levels in water resources management. The mission is to engage young Mediterranean water professionals to create and share knowledge, build capacity and amplify their voice on the regional and global water agenda.

The MedYWat general objectives are:

1. To connect and engage Mediterranean youth from different disciplines working on water.
2. To become a knowledge-based platform which creates and exchanges best practices and opportunities for Mediterranean youth.
3. To create cross-linkages between MedYWat and key decision makers in the Region.

MedYWat organizes and participates in MED workshops, seminars, and webinars, among others, specifically those concerning young water professionals, targeting key Mediteranean institutions and leaders in the water agenda in order to build partnerships with the MedYWat Network and to promote the work of its members.

MedYWat has been working on promoting the role of youth in international events. For instance, a delegation of MedYWat members has participated in June 2018 in the Water Decade high level conference in Dushanbe, Tajikistan, iunteracting with high level decision makers and with the water youth professionals from Central Asia. Another delegation also participated in the International Water Association seminar in Murcia, Spain, bringing at the forefront the role of youth in water management. In September 2018, members of the network raised awareness on the role of youth and gender in the water sector at the Women, Water and Youth conference in Amman, Jordan. The active participation of youth which took place at the conference occurred in parallel with the promotion of monthly network webinars designed to produce and share knowledge among its members. A good member of the network is considered as a person who is active and ready to exchange ideas with other members, as well as with the wider community. Currently, the network is working towards the World Water Day 2019, whose theme is "Water and Migration". The network is organizing the MED Water Heroes Contest and conference in Marrakech, Morocco, in March 2019, as well as an internal call for papers on issues relating to water and migration.

Focusing on water education, water governance, water treatment and reuse, water management and planning, sustainable blue growth and water and migration, MedYWat works creating an active platform of collaboration between young water professionals in the Mediteranean in order to insure a better water management and knowledge transfer. Further, the network challenges and seeks opportunities for young water professionals seeking to be able to interact and create positive change together with regional water institutions.

Future of Food: Journal on Food, Agriculture and Society, 6 (2)

CBD Alliance Closing Statement - COP 14 Egypt, 2018

UN BIODIVERSITY CONFERENCE
Investing in biodiversity for people and planet
COP 14 - CP/MOP9 - NP/MOP3
Sharm El Sheikh, Egypt, 2018

Madame President

We thank the Egyptian people for all their hard work and kind welcome and look forward to their leadership towards COP 15. We also warmly thank the CBD Secretariat for their dedication and commitment.

On conflict of interest. We are glad to see good progress so far on developing a policy. We think this should also be extended to consultants working with the CBD.

On Digital Sequence Information. We are pleased that this important work will proceed in an open ended working group but are dismayed by the unacceptable refusal of Europe and many other developed countries to fulfill their benefit sharing obligations under the Convention and Nagoya Protocol.

On gene drives: we are pleased that this body has recognised the high risks of the new Exterminator Technology, and has effectively increased the precautionary measures around it, including the establishment of an AHTEG to analyze its risks. It is particularly important that recognition was given to the potential impact on indigenous peoples and local communities, and that they will need to be consulted.

The dangers posed by this novel technology - including that a single release of certain gene drives can have transboundary and even global impacts– merits that the next CBD COP establish a full moratorium, to prevent the extermination of species and the cascade of impacts it would have on biodiversity.

Regarding the Aichi Targets, we are concerned that they have not been sufficiently addressed by this COP, when we still have 2 years for their effective implementation and achievement.

On mainstreaming: In order to prevent further destruction of biodiversity and breaching of planetary boundaries, it is now urgent to avoid major new projects in the energy and mining, infrastructure, manufacturing and processing sectors overall in biodiversity sensitive areas.

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We have noticed some worrying trends in the way that discussions are managed. We stress that we want a CBD process to be as clear, open and participatory as possible, fully respecting rules of procedure.

Finally, the post 2020 Framework shall:

First. Be based on consultations that clearly include the effective and meaningful participation of NGOs, indigenous peoples and local communities, women, youth and rights holders. Our work does not favor private interests but rather looks after the public good.

Second. Fully recognize The Rio Declaration 1992 and its principles, in particular the prevention and precautionary principle, as well as principle 10 on access rights in environmental matters.

Third. Enshrine a rights-based approach. It is urgent to protect those individuals who work fiercely every day, often risking their lives, to defend the environment and human rights of themselves and their communities.

Fourth. Set up a plan to stop the underlying drivers of biodiversity loss and degradation, particularly agribusiness, mining, energy, production and manufacturing.

Fifth: Take concrete actions to shift away from our current development system of overconsumption as the real transformative change.

Sixth: Apply the non regression principle to the whole CBD process, building on the Aichi Targets as a minimum standard.

Thank you Madame President

Source: https://www.cop14-egypt.com (direct cited)

Future of Food: Journal on Food, Agriculture and Society, 6 (2)

Innovations in Technologies for Fermented Food and Beverage Industries

A review by Pamela Estefanía Alcocer Martínez

Editors: Sandeep Kumar Panda; Prathapkumar Halady Shetty
Publisher: Springer International Publishing AG
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Length: 339 pages

Fermentation is a process that employs the metabolism of microorganisms. Its applications and outcomes are important not only to the food industry, but also for the consumers that associate fermented products with health benefits. Innovations and advances in the field of food and beverage fermentations are discussed within sixteen chapters that differ in focus and depth.

Starter cultures can be composed of selected single or multiple strains and aim to deliver desired characteristics to the final product. The strategies to improve starters are wide and include co-cultures or genetic engineering. The selection criteria consider factors, such as metabolic activity, characteristics of the microbe, the development of the culture and the final sensorial. A classification of fermented foods is offered based on the substrate. The fermentation processes are classified by alcoholic fermentation, where ethanol is obtained mainly by yeasts, and lactic acid fermentation by lactic acid bacteria (LAB). The book names the principal microorganisms normally involved within fermentations, which include bacteria from Lactobacilli, Acetobacter, and Bacillus, and yeasts from Saccharomyces family. Furthermore, the use of fermented food as functional food is also explained. Also, the associated health benefits are mentioned, such as the higher concentration of bioactive compounds present in fermented in comparison with the product before fermented. In addition, an overview of the current market of fermented foods and future projections are presented in the first chapter.

The use of LAB as a starter provides both advantages and functionalities, such as enzyme release. The role of starters to deliver safe fermented products with potential to address protein needs or nutritional disease issues, especially in developing countries, is explained in chapter two. Other advances in the field of fermentation include the biologically active peptides with health purposes, including technological processes such as the use bacteriocins for food preservation (e.g.nisin in dairy products). A list of fermented food with the associated microorganism and health benefits are provided in chapter Three.

Chapter four discusses the selection criteria and characteristics of starter cultures. The chapter explains the advantages and the disadvantages of using thermal processes for extending shelf life. Moreover, it explains the mechanism of the non-thermal processes and its importance for fermented products for decontamination, providing examples of real uses. Some research on food metabolomics and potential techniques are briefly explained, such as encapsulation to deliver bioactive components. There are several advances in the field of alcoholic drinks which include innovations in craft distilling, development of beer concentrate for household equipment, and the creation of edible material to contain six-pack beers. These developments and the demand of low or non-alcoholic drinks/beer are linked with healthy trends as described in chapter five.

Understanding the Millennials as consumers is substantial. Chapter six depicts concrete examples of the importance of apps and social media as marketing strategies. The advantage of new technologies is that they act as a platform to gather consumer insights, and can be used to create dining experiences.

Chapters Seven and Eight cover a wide range of topics,

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such as current and potential novel methods of food delivery, preservation, storage and industrial production for probiotics and functional food. The chapters also demonstrate the procedures of benchmark selection, food safety aspects and functional properties of probiotics from dairy sources. Moreover, the chapters demonstrate some ethical concerns, regulatory status, food markets and companies. On the other hand, chapter nine focuses on non-dairy probiotics. It categorizes these products and backgrounds by origin and trends.

Meat fermented products are a very important topic in the industry. Chapter ten discusses standardization of meat fermentation and compares it with the spontaneous fermentation. It explores the advantages, disadvantages, advances, and improvements with regards to hazards and contaminants from a microbiological origin and quality issues. The chapter gives examples on some microbial hazards that are naturally present in fermented meat, such as antimicrobial resistance or opportunistic behaviour. Other examples are Mycotoxins, moulds in homemade sausages, and biogenic amines.

Chapter eleven explores the fermenters' or bioreactors, materials, functionality and components that are introduced for wine and beer. It presents the important features that should be taken into consideration for the equipment which depend on the raw materials, budget, capabilities, and the desired outcome. In addition, it shows how nowadays the modern fermentations are linked to computers for data storage and analysis.

Chapter twelve analyzes the use of Genetically Modified (GM) Foods as one option for food-related problems, mentioning advantages such as a higher production worldwide in limited space, a way to address malnutrition, and the design of GM microorganisms to develop or inhibit the specific metabolites. Some examples for overcoming problems in the bakery, wine, and brewing industries and folate production are also mentioned. The chapter presents the main disadvantages (the main disadvantages of what?), such as the unknown consequences and environmental risks with regards to the resistance to antibiotics, herbicides or insects. Additionally, the risks for human health concerning toxins and allergens, and issues referring to traceability and regulations are also explained.

Chapter thirteen illustrates the topic of packaging, including some developments and improvements. For example, the importance to match the current sustainable trends, the advances that include RFID (radio frequency identification), the active packaging for absorbing undesirable substances, and the smart packaging for monitoring purposes.

Consumer demands and product acceptability shape the novel foods market. Therefore, market research and sensorial analysis are tools applied often in product development. Chapter fourteen explains the importance of innovation achieved by companies and consumers together towards the development of the desired product. Scepticism from the side of the consumer with regards to the processed foods leads to a growth on a minimally processed, natural and organic market and present conflicts with developments, such as nanotechnology or GMOs.

Intellectual Property (IP) is used by the food industry to keep the business profitable. Patents are widely used by companies to protect themselves? from the formulation, new technologies?, or even as a way for commercialization. The main categories that are protected under this instrument are fruits, vegetables, drinks and beverages. Chapter fifteen explains how the use of copyright is directed mainly for advertising or texts with marketing purposes, whereas industrial design refers to the physical attributes of the product with the objective to increase recognition by the consumer.

The normal percentage of residual sugars in wine fermentations are normally standardized less than 0,2-0,4%. The most common problems are hard to anticipate and include "stuck fermentation", in which a higher amount of residual sugars is produced, and "sluggish fermentation" in which a less efficient fermentation is produced. Both cases lead to economic and food loses. The last chapter of this book explains a computational intelligence approach based on multivariate statistical to anticipate these undesirable deviations in wine fermentations. Although the topics from this book can be seen as miscellaneous, it can be noted that the technologies for fermented food are in continuous improvement with the aim to deliver palatable and safety fermented products to consumers.

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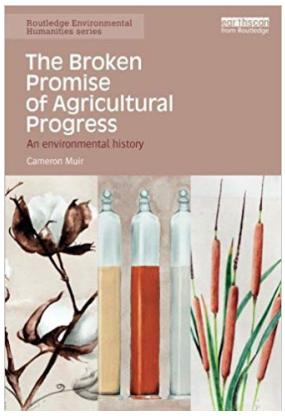
Future of Food: Journal on Food, Agriculture and Society, 6 (2)



The Broken Promise of Agricultural Progress: An environmental history

A review by Sören Köpke

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Cameron Muir's work "The Broken Promise of Agricultural Progress" is an excellent example of what environmental history can achieve. He traces the development of agriculture in a particular region, Australia's New South Wales, from the 1840s to the end of the 20th century. In essence, it is a history of failed attempts; a story of changing attitudes and anxieties, of temporary fads and grand hopes, of conflicts and contradictions. New South Wales is not a land that lends itself easily to agriculture, yet Australians have time and time again tried to reap profit from this land through livestock, groundwater exploitation, and intensive crop cultivation.

"This place isn't romantic enough to write a book about", Muir quotes an unnamed National Park officer at the beginning of the text. New South Wales is an arid to semi-arid region and state of Australia, an unforgiving, hard environment.

Muir's work, however, is anything but dry. It presents a lively, informed account of agriculture in a dryland. The introduction connects the subject matter to other concerns of the environmental humanities research agenda, addressing questions of "ecological imperialism" (Alfred Crosby) or the "Slow Violence" (Rob Nixon) of environmental injustices. Although New South Wales is a specific territory that came into existence only through colonization in the 18th century, its history is deeply enmeshed with global history.

Muir does not only discuss agriculture, but also the way its ambitions are again and again frustrated by environmental conditions.He also weaves aspects like gender roles, racism, ideas on scientific progress and public health into his narrative. The shifting imaginaries and attitudes to local "nature", be it in science or public opinion, take up a good part of the account. One-word chapter titles like "Hooves", "Wheat", "Dust" or "Cotton" structure the book. Indeed, chapters could almost be read separately. One pitfall of his work could be that it is too densely written. Muir's attempt to highlight the complexity and depths of each phase of agricultural development sometimes affects the clarity of his arguments. On the other hand, the brevity of the chapters also adds to the high readability of the book. Historical photographs, graphs and other source material also aptly illustrate the work.

"The Broken Promise of Agricultural Progress" already bears its conclusion in the title. Modernist expectations of the prevalence of human ingenuity over nature are frustrated. Always, the hardship of working the land connects to problems of water management, to the vulnerability of local ecosystems. Colonization, armed with Western science, produces dissatisfactory outcomes. This is an important contribution to the environmental history of modern agriculture, one that shatters the triumphalist perspective on "progress" that is so often brought forward.

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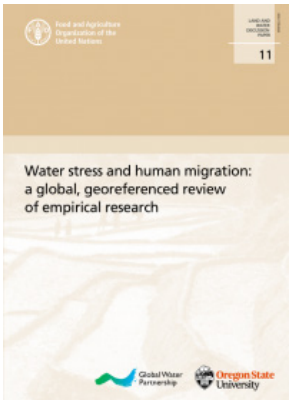

Water stress and human migration: A global, georeferenced review of empirical research

A review by Ghadeer A. Arafeh, Pr. AZIZ Faissal, Kholoud Al Ajarma

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Patterns of human movement have always been affected by the continuous changes in climate and weather patterns, in addition to the availability of and access to natural resources, including water. Today, concerns over how these changes might affect migration are growing and there is a need to understand the relationship between water stress and migration. Therefore, our analysis looks at the latest study of FAO Land and Water Division (CBL) and GWP Technical Committee (TEC) on "Water stress and human migration: A global, georeferenced review of empirical research." The study in question assessed 184 peer-reviewed, empirical research articles selected for their focus on linkages between water stress and human migration. The literature studied in great detail the relationship between dryland crops and water stress. Crop water stress is discussed as a result of a lack of access to water for irrigation, water stress and migration in sending areas, and water stress and migration in receiving areas. In general, the literature reveals a strong consensus that increased water stress can cause people to decide to migrate.

Furthermore, this review maps the geographic distribution of water stress-migration research at the sub-basin level and compares it with expected changes in water stress that are likely to occur as a result of climate change over the next 30 years, identifying places where future research efforts could produce useful information. Historically, political, economic and demographic contexts can help in explaining the factors that influence the migration options when changing environmental conditions make livelihoods more difficult. The papers discussed in this review focused on a direct relationship between four categories of water problems and migration: 1) agricultural problems (i.e. drought, changes to growing periods); 2) flooding vulnerability (i.e. rivers, coastal inundation); 3) water infrastructure problems (i.e. water scarcity or water quality); and, 4) water conflict (i.e. social conflict over access to or use of water resources).

The studies show that there are clear instances in which conditions of water stress affect livelihood expectations, destroy assets and alter rates at which people change residences on a temporary, seasonal, cyclical or permanent basis. Nevertheless, migrant networks and corridors are not new, and when water stress drives new patterns of migration, they usually fold into existing spatial, temporal, seasonal and economic patterns of migration. water stresses, such as drought, dry spells, and rainfall extremes, may accelerate migration patterns. However, migratory responses to water stress remain context-dependent and can vary from region to region. In addition, heat exposure can be identified as a stronger predictor of migration than drought, increasing climate variability or extreme rainfall and flooding. Finally, the studies discussed emphasized the strong link between institutional and policy failures on the water stress-migration link.

The results of these papers were geocoded and plotted on watershed sub-basin level maps as an indicator of the water crisis. The maps contrast the indicators to project changes in temperature degrees and annual cumulative precipitation in order to identify geographic disparities between existing water stress migration studies. Identifying these differences leads to the disclosure of the trigger points that demonstrate water stress-migration relationships. Despite the fact that the analytical findings discussed in this paper were enormous and the in-

formation provided in the review covered most aspects of social, economic, political and environmental changes and their influence on migration from different perspectives, they were not sufficient to provide a comprehensive illustrative of the global phenomenon of migration in association with climate variables especially in relation with water-stress. Although the papers analyzed in the review covered numerous counties, the annual projection of the population growth of each discussed community has been underestimated, leading to a lack of analytical views on which the paper is based. There could have been more effort put into linking the consequences of the migration with the actual time of study to insure the accuracy of the data and analytical discussion given.

In addition, the state of depending the geographic disparity on the number of reviewed papers in a particular community as an evidence of the greatest impact of massive rates of migration currently underway globally is not a scientific method followed that may indicate there is a possibility of existing other literary studies not written in the English language, which have covered part of the gap.

The reviewed paper acknowledges the positive impact of organized migrations, whether internal or external on development planning of both home and host countries, which was intensively covered as indicated through this report. In contrast, the paper only mentions five research papers that have covered aspects of irregular migrations (caused by natural disasters or civil or regional wars). Irregular migrations adversely affect all socio-economic, political and environmental perspectives of both home and host countries because of the influx of immigrants in huge numbers at once, not to mention the abandonment of people from their home and political instability. Furthermore, the lack of transparent data documenting the wars and their effects, and the lack of sufficient research in the time led to the imbalance of knowledge, which we saw in the report. There is a need for more research on these themes in order to build explicit strategies related to conflict over natural resources, conflicts and wars to be able to produce more balanced results. Despite this, however, a solution was offered in the discussion paper to overcome these obstacles by giving priority to research that uses spatially disaggregated time-series data generated from non-typical sources, such as mobile phones and social media activity.

The discussed paper offered an overview of what has been studied in relation to water and migration. The study, however, must be more specialized and comprehensive; that is, to include case studies and perhaps offer a follow up on the issues of water and migration by interviewing the affected migrants while involving all stockholders in future and further studies. More could also be done by looking at different patterns of human movement including internal or external migrations, regulated or unregulated migration, and draw recommendations accordingly by applying best practices for adaptation.

The paper concluded that changes in migration patterns, within countries and between countries, can be used as anindicationof agricultural problems. Therefore, rural agricultural adaptation and livelihood diversification programmes (i.e. drought and heat tolerant crop varieties and sustainable intensification technologies) are given as possible examples for attenuating environmental stress as a determinant of migration. Rural agriculture adaptation, however, was never a solution, because in case of a water shortage, agriculture could not exist. For this reason, it is usually taken into consideration the the Water-Food-Migration nexus. However, this solution may be efficient if the root causes of migration is the youth unemployment. Moreover, a model for sustainable agriculture should be more specified.

Furthermore, to be able to define relationships between phenomena, one should base them on clear and direct indicators. For example, the use of the case of marriage movements of women as an indicator to prove that water scarcity contributes to furthering poverty as shown in the paper is not a reliable indicator. This indicator could be related to social or biological causes rather than environmental ones.
We find the reference made in the paper to migration as “adaptation" misrepresentative. For example, during last decades in which the migration has shown a peak, the principal causes for migration were wars, climate changes and economic crisis (youth unemployment). These three factors had different causes mainly poor governance (war and economic crisis), industrial activities causing pollution and thus inducting climate change. The paper does very little to discuss such causes and therefore does not address the roots of the problems but rather the results of such problems, water-stress and migration.

Moreover, the paper shows a huge empirical gap in the global coverage of water stress and human migration. It suggests that further hypothesis should be more detailed in systematic ways for predicting migration rates under different climate scenarios as well as to achieve a global contribution and update strategies in this concern. The socio-economic, policies and environmental

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factors that shape the framework of each country differ among countries. The latter will result in insufficient evident data to explain the magnitude of the change if no scientific regression is used based on statistical evidence for each country and linked it to the rate of annual migration.

Considering the multiple categories of the relationship between water scarcity and migration (sometimes cause and sometimes consequence), further study of this theme is recommended which takes into consideration the root causes of migration and water scarcity. Moreover,it necessary to develop a model guide to cope with this phenomenon in order to urgently react to water scarcity and limit the impact of this eternal link between these two socio-environmental poles.

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