Creating the Food Sovereignty Index for Measuring the Agricultural Production Sufficiency: Case of 2012 Metropolitan Law in Türkiye

In this master's thesis, I will propose a composite index for measuring food sovereignty. As a humanitarian problem, the concepts of food insecurity and hunger have globally iterated firstly under the convention of food security, at the Food and Agriculture Organization's 1974 World Food Summit at Rome. However, the consumer-oriented mass production approach lacked the capacity to maintain indigenous communities' agricultural productivity resilience. In 1996, La Via Campesina supported the theorization of food sovereignty, later joining the 1996 World Food Summit to underline the principles. La Via Campesina's point of view regarded food security as a part of food sovereignty, however, food sovereignty comprises habitual preferences, ecological resources, and self-reliance in production chain. This point of view, therefore, take a step further from dietary intake sufficiency of food. Global food intake indexes focuses on measuring the food security, yet the efforts to handle food sovereignty is being discussed more along with agricultural sustainability. In 2012, Türkiye has accepted the renovated model of the "Metropol Law" (Büyükşehir Yasası) to be integrated in 2014. The last iteration of the Metropol Law, Law 6360, changed the governance districts and model of the metropol cities' peripheries and center. There has been debates whether the central autonomy is corresponding to local communities in villages. The eco-social aspect complicates the analysis of this structure because of the intersectional human factor, that might be the reason why existing food sovereignty indexes are driven by global indicator availability and organizational theoretical conceptualizations. Critical selection by manual reading of area studies of Türkiye is undermined to create the corpus of the composite index indicators based on food sovereignty theories for overcoming data bias. Web scraping and automated topic selection methods are used to policy analysis of the Official Gazette to include national legislations towards agriculture. The food sovereignty index is used to compare the difference of the new Metropol Law, based on computationally supported econometric approaches. In results, the paper concludes that the loss of food sovereignty is not particular to Law 6360 treated cities, but Türkiye in general has a loss in terms of domestic agrifood production means after the acceptance of the Metropolitan Law.

Introduction

Food Security concept was proposed in 1974 World Food Summit. Then, twenty years later the international farmers organization named la Via Campesina joined 1996 World Food Summit following the organization's 2nd International Conference which was held six months before the summit. Their opposition was the emphasis on increasing the global trade and agricultural mass production that is put forth by the Food and Agriculture Organization (FAO) at the World Food Summit. According to La Via Campesina, food security is a part of food sovereignty, however, the concept omitted indigenous farmer's voice to be a complete approach to tackle hunger and malnutrition in relation to ecological and cultural aspects. In

other terms, La Via Campesina defends that, FAO's meeting resulted in neoliberal policies which supports high-scale production and export-oriented behaviors. In return, local communities and domestic resources were negatively affected by global competition and profit-oriented farming. Based on these discussions, protection of rural livelihood and gender equality has been added in later iteration of World Food Summits, yet, the agricultural sector is very much an informal sector to measure the substantial impact of these declarations.

The need for a composite index of food sovereignty therefore arises due to the need of indigenous communities for understanding the urban-rural shift, and the issues of access and autonomy in global and domestic agricultural market flow. Since this shift is not considered by global food security approach on the production and consumption levels, there has not been an established index published by an institution. On the other hand, food security indexes that measure the sustainability of agricultural production regarding output volumes and food affordability by household budgets are more prevalent. To sum up, I would propose the distinction of focus between the food security and the food sovereignty as such: The first's focus on food production, distribution, and consumption, while the second's focus on the protection of rural communities by supporting their traditional choices for agricultural crops and socioecological habitats.

This dissertation's research question aims to understand agricultural and rural governance policy effects to food sovereignty in Türkiye Republic. The last Metropol Law, Law 6360 accepted in 2012, changed the status of fourteen cities. The Metropol Law redefined the center and periphery by changing the role of participation of neighborhood units and sub-provincial municipalities, for centralization of provincial municipalities in regarded cities. The resulting structures show expropriations, thus demanding new infrastructure costs by metropolitan municipalities. The change was drastic, followed by fourteen new metropolitan cities in addition to existing sixteen metropolitan cities, nearly doubling the metropolitan cities in an instance. The paper's focus is to understand on agroecological production terms whether there is a difference between new metropolitan cities before and after the law, and whether these cities show divergence from the rest of the cities in Türkiye.

Literature Review

Section here provides and overview of discussions on food security and food sovereignty in relation to socio-ecological aspects of agricultural food production. In the first part, the concept of food insecurity is discussed with climate problems of agricultural production. Later on, the theoretical conceptualization of food security and food sovereignty is explained with global diplomatic processes. Afterward, global market structure and domestic policies are take into account regarding local producer-consumer behaviors about ongoing situations. Lastly, the most recent responses to global agrifood systems for the resilience and organization of local networks are discussed.

Food Insecurity and Agroecology

Every human requires food to sustain their life. For this reason, food insecurity is a global concern for parliaments, but especially in developing countries where there is economic

instability[1] (World Bank, 1986). Sufficiency of dietary intake can be interpreted in different ways, such as by caloric consumption or nutrient composition. Measuring food consumption via aggregated national or regional per-capita metric can be misleading since the inequalities differ in different levels[2] (Mena-Vasconez et al., 2016). Therefore, measuring neighborhoods' socioeconomic levels to locate communities in need is a useful practice for social municipal work.

Protection against food insecurity requires supply of adequate food for households. For this reason, all phases of production, distribution, and storage are being needed to be taken care of to have sufficient food access. Otherwise, people will not be able to purchase food from the markets due to economic constraints, as a result, more food production would become wasted at market prices[3] (World Bank, 1986). On the other hand, excessive agricultural food production might decrease the market prices, via export and import choices for market offers. In case of a shift of this kind, farmers' ability to sustain themselves until the next harvest will decline in a competitive market. Since there are more than a single passage point between farm to fork, redistribution considering the market dynamics should be cautiously considered.

Agricultural food prices are defined by multiple factors. Depending on the region, currency exchange rates, and local input prices such as energy, will be volatile due to the complex nature of global interactions. Additionally, some of the basic materials to cultivate food, such as seeds and fertilizers, might or might not be dependent to the external locations from where the crops have been sowed. Future policy expectations on subsidies will alter crop selection due to budget targets. In return, the uncertainties that affect farmer decisions will alter the agricultural production estimates. As a result, markets will be destabilized because of future return expectations on agricultural production[4] (Demirdöğen et al., 2022). In the end, the risk factor will either put farmers at a risk of going out of business or force consumers to buy at a markup price relative to production costs.

Between the market structure where the farmer sells and the retail buys, food sovereignty theory adds regional self-sufficiency and national control aspects to the food and agriculture discourse. Food sovereignty term was first mentioned by the Mexican Government program in the 1980s, however, similar usages have appeared in other countries of Central America[5] (Edelman, 2014). The appearance of the term is important for implying the tension between global competitive markets and developing countries. The influence of foreign direct investment in these countries poses a threat by destabilizing domestic prices, therefore

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[1] Poverty and hunger :issues and options for food security in developing countries. (1986). Washington, D.C. : World Bank.

[2] Mena-Vásconez, P., Boelens, R., & Vos, J. (2016). Food or flowers? Contested transformations of community food security and water use priorities under new legal and market regimes in Ecuador's highlands. Journal of Rural Studies, 44, 227-238.

[3] Poverty and hunger :issues and options for food security in developing countries. (1986). Washington, D.C. : World Bank.

[4] Demirdöğen, A., Olhan, E., & Hasdemir, M., (2022). Heterogeneous impact of agricultural support policies: evidence from Türkiye. Environment Development and Sustainability , vol.24, no.10, 12203-12225.

[5] Edelman, M. (2014). Food sovereignty: forgotten genealogies and future regulatory challenges. The Journal of Peasant Studies, 41(6), 959–978. https://doi.org/10.1080/03066150.2013.876998

becomes a topic of discussion for the interpretation of food security and citizens' resilience[6] (Cibils, 2021).

Climate change carries and important concern about agriculture. Agricultural productivity both affects natural resources and is being affected by environmental conditions. Problems of climatic shift deriving from issues such as drought, soil salinity, floods, and air quality which are related to the intensive use of agricultural inputs over a small area[7] (FAO, 2016). The quality of life of rural residents is sensitive to rural land use practices. Therefore, increasing agricultural production without calculating external effects would have detrimental results in the case of lacking precautions against climate impacts of intensive land cultivation. The agroecological approach is a concept that considers the balance of ecological sustainability in agricultural practices. Yet, agroecology is interpreted differently in different parts of the world[8] (Levidow, 2015).

International food trade opens new discussions about the national profit generating agricultural production. Intensive land cultivation, intensive water use, durable and high-yielding GMO crops, and reliance on artificial fertilizers and pesticides create a dichotomy between indigenous communities' and nation's outputs[9] (Ziegler, 2003). Such dichotomy would also indicate the preferences of agrobiodiversity, which is an issue related to plant variety rights over reproduction and conservation of seeds[10] (Bowman, 2015). The output oriented agricultural approach, using high economic capital and resource-intensive methods, would lead to monoculture production that causes degradation of local seed varieties. The agroecological approach, on the other hand, prioritizes the conservation of the environment by cultivating local seed diversity, polyculture farming, and indigenous application methods of fertilizers and pesticides[11] (Şişman, 2023).

In 2023 report for food and agricultural indicators, FAO mentioned eight Sustainable Development Goals (SDG) under this category. These are No Poverty (Goal 1), Zero Hunger (Goal 2), Gender Equality (Goal 5), Clean Water and Sanitation (Goal 6), Reduced Inequalities (Goal 10), Responsible Consumption and Production (Goal 12), Life Below Water (Goal 14), Life on Land (Goal 15)[12] (FAO, 2023). Therefore, the complete picture of SDGs will vary from region to region, depending on the urban-rural division and types of economic activities. As a result, tracking the SDGs on a national level will lack the local nuances for the country.

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[6] Garcia-Arias, J., Cibils, A., Costantino, A., Fernandes, V. B., & Fernández-Huerga, E. (2021). When land meets finance in Latin America: Some intersections between financialization and land grabbing in Argentina and Brazil. Sustainability, 13(14), 8084

[7] FAO (Ed.). (2016). The State of Food And Agriculture - Climate change, agriculture and food security. FAO.

[8] Levidow, L. (2015). European transitions towards a corporate-environmental food regime: Agroecological incorporation or contestation?. Journal of Rural Studies, 40, 76-89.

[9] Ziegler, J. (2003, October 31). The right to food :report : addendum /. Retrieved from https://digitallibrary.un.org/record/506617/files/E_CN.4_2004_10_Add.2-AR.pdf

[10] Bowman, A. (2015). Sovereignty, risk and biotechnology: Zambia's 2002 GM controversy in retrospect. Development and Change, 46(6), 1369-1391.

[11] Şişman, B. (2023). Ankara Kırsalında Tarımsal Gıda Sistemi Olarak Agroekolojinin Sosyolojik Analizi. Sosyoloji Araştırmaları Dergisi, 26(2), 230-253. https://doi.org/10.18490/sosars.1382530

[12] FAO. 2023. Tracking progress on food and agriculture-related SDG indicators 2023. Rome. https://doi.org/10.4060/cc7088en

Food Security

Food security is first mentioned as a collaborative framework for reducing hunger and famine by facilitating global trade and increasing government budget on agriculture and food subsidies. In 1974, the World Food Summit was held in Rome for these targets, because of the food crisis at the time[13] (FAO, 1975). Problems have arisen due to natural disasters, which as a result, countries' food stocks come into a crisis. As a response, the leaders have proposed to change the world's food stockholding and information-sharing systems while easing international trade tariffs for a fast response to immediate and future food crises.

In 1996 World Food Summit, in which la Via Campesina was a participant, redefined food security as: "Food security exists when all people, at all times, have physical, social, and economic access to sufficient, safe, and nutritious food to meet their dietary needs and food preferences for an active and heathy life"[14] (FAO, 1996). Later in 2009, the four pillars of food security defined as "availability, access, utilization, and stability"[15] (FAO, 2009). Food security agreements that were made at the World Food Summit were underinvested, as a result, the target of reducing world hunger levels to desired levels was unattainable[16] (Ziegler, 2003).

Historically in global perspective, the first approach for reducing hunger rates to feed vulnerable populations was to rapidly increase agricultural production with international trade and farming technologies against famine. Therefore, high-yielding crop varieties such as corn and soy, special fertilizers and pesticides were at the center of focus in research and development[17] (Furat, 2013). Mainly, industrial crop types such as cotton, corn, and soy spread rapidly. Corn and soy were processed for utilizing in packaged foods and animal feed[18] (FDA, 2024). As a result, providing caloric intake became cheaper and easier to sustain.

Food Sovereignty

The concept, food sovereignty, was first used in Central America during 1980s[19] (Edelman, 2013). Earlier utilizations defined the term as national self-sufficiency. Later, the international farmer organization La Via Campesina, expanded the term for covering indigenous communities' rights to agricultural food (agrifood) system over their own territory[20] (Via Campesina, 1996). Agricultural aspects and food production cover more than the equation of

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[13] Report of the World Food Conference, Rome, 5-16 November 1974. (1975). Retrieved from http://digitallibrary.un.org/record/701143/files/E_CONF.65_20-AR.pdf

[14] Rome Declaration on World Food Security and World Food Summit Plan of Action :World Food Summit, 13-17 November 1996, Rome, Italy. (1996). Rome : FAO.

[15] World Summit on Food Security Rome, 16-18 November 2009 Draft Declaration of the World Food Summit on Food Security. (2009). Retrieved from https://www.fao.org/fileadmin/templates/wsfs/Summit/Docs/Declaration/WSFS09_Draft_Declaration.pdf

[16] Ziegler, J. (2003, October 31). The right to food :report : addendum /. Retrieved from https://digitallibrary.un.org/record/506617/files/E_CN.4_2004_10_Add.2-AR.pdf

[17] Furat, M. (2013). Küresel Politika Değişimleri ve Türkiye'de Kırsal Kalkınma. Gaziantep University Journal of Social Sciences, 12(3).

[18] https://www.fda.gov/food/agricultural-biotechnology/gmo-crops-animal-food-and-beyond

[19] Edelman, M. (2014). Food sovereignty: forgotten genealogies and future regulatory challenges. The Journal of Peasant Studies, 41(6), 959–978. https://doi.org/10.1080/03066150.2013.876998

[20] Via Campesina. The Right to Produce and Access to Land - Food Sovereignty: A Future without Hunger. (1996). https://viacampesina.org/en/wp-content/uploads/sites/2/2021/11/1996-Rom-en.pdf

supply and consumption volumes. Global competition, biotechnology, high-tech farming drove indigenous communities out of business, leaving them landless and precarious in the agricultural sector.

Food security emphasized international trade and agricultural production with low tariffs and high capital. Peasants' loss of control of agricultural production because of dumping of imported subsidized agricultural products caused unfair competition and land accumulation[21] (Ünal, 2020). Food sovereignty set forth in 1990s by La Via Campesina for the protection of local communities against neoliberal policies' development[22] (Claeys, 2018). In the food sovereignty approach, local communities should have the right to protect their own culturally inhabited areas, by using culturally appropriate agricultural practices[23] (Yıldız & Özkaya, 2024).

Although the usage has been increasingly employed since the iteration of La Via Campesina, the definition of food sovereignty varies by the scope of interest. Because the theory emphasizes the control of local groups over food production and distribution, the scope may be defined by political governance territories, scale economies, or institutional settings of rights and responsibilities[24] (Schiavoni, 2015). As a result, theoretical discussions of food sovereignty can get blurred in a combination of multiple definitions of sovereignty. In short, food sovereignty's conceptual usage has a flexible definition in the agrifood system from farm to fork.

Domestic and International Policies

Food Security highlighted a more open agricultural food market with lower prices, high specialization, and efficient agricultural production in relation to the market demand[25] (FAO, 1974). As a result, economies of scale favored capital-intensive and high-output agricultural corporations in production, trade, and technology. However, newer policies tend to be more inclusive towards small-scale farms[26] (Demirtaş & Kaya, 2018). Policy framework played its role in choosing which initiatives would have been favored, regarding production and consumption needs, in addition to productive efficiency[27] (Cihangir et al., 2015). Consequently, governmental bodies facilitated the dumping of imported products, land consolidation for specialization in selected crop types, and utilization of genetically modified breeds, and chemical fertilizers and pesticides for intensive agricultural cultivation.

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[21] Ünal, H. E. (2020). Türkiye'de Kırsal Değişme Süreçleri. Sosyal Ve Beşeri Bilimler Araştırmaları Dergisi, 21(47), 22-49.
[22] Claeys, P. (2018). The rise of new rights for peasants: from reliance on NGO intermediaries to direct representation. Transnational Legal Theory, 9 (3-4), 386-399.
[23] Yıldız, M., & Özkaya, T. (2024). Pioneering Communities in Dissemination of Local Wheat Varieties and Products in Türkiye. Tekirdağ Ziraat Fakültesi Dergisi, 21(2), 309-323. https://doi.org/10.33462/jotaf.1217580
[24] Christina M. Schiavoni (2015) Competing Sovereignties, Contested Processes: Insights from the Venezuelan Food Sovereignty Experiment, Globalizations, 12:4, 466-480.
[25] Report of the World Food Conference, Rome, 5-16 November 1974. (1975). Retrieved from http://digitallibrary.un.org/record/701143/files/E_CONF.65_20-AR.pdf
[26] Demirtaş, B., & Kaya, A. (2018). Evaluation of Public Agricultural Extension Programs: The Case of Hatay Province (Türkiye). Türk Tarım Ve Doğa Bilimleri Dergisi, 5(2), 203-210. https://doi.org/10.30910/turkjans.421369
[27] Cihangir, H., Bilgiç, B., & Aba, T. (2015). IPARD Makine ve Ekipman Desteklerinin Mardin Tarımına Etkisi. Tarım Makinaları Bilimi Dergisi, 11(1), 25-31.

However, rural communities are affected negatively by the economies of scale. Capital-intensive, high-output cultivation created competitive food prices in domestic markets[28] (Kızılaslan & Dağdelen, 2023). High-value crop types became more prevalent, such as avocados, which disrupted regional accessibility to traditionally consumed food[29] (Karsak, 2024). Export and import subsidies increased the trade flow, which caused the fleeing of high-quality regional food and substituting with low-quality imported products. In the process, the farmer migration caused de-ruralization and de-agrarization, by weakening the rural livelihood resilience in highly competitive global economy[30] (Dunford, 2015).

Multinational corporations' revenues surpass some of the developing countries GDPs in which they operate. In 2004 report of the UN, 10 organizations (including Aventis, Monsanto, Pioneer, and Syngenta) were controlling 80% of the global pesticide market and 1/3 of the commercial seed market. In South Africa, Monsanto alone was controlling 90% of the wheat market[31] (Ziegler, 2003). As a result, multinational corporations have a substantial impact on food preferences, as they have the power to monopolize the agricultural food chain from production to retailing.

Increasing food production and trade caused a shift in crop type selection for planting. Instead of locally grown food with domestic seed varieties, farmers turn towards choosing export crops which may reduce regional food availability[32] (Louis, 2015). Additionally, global trade affected regional food preferences by eliminating local plant varieties by increasing imported food supply[33] (Timmermann & Robaey, 2016). In rural daily practices, what was before a labor-intensive sector can become capital-intensive sector, leaving rural households out of their traditional jobs and increasing inequalities between land-owner and non-land-owner households[34] (Mühlenoff, 2021).

Short Chain and Global Chain Agrifood Systems

Agrifood systems encompass all stages of agricultural production from farm to fork, including fishery and aquaculture, livestock husbandry, and forestry activities as well[35] (FAO, 2024). In this paper, the term "agrifood system" will be limited to agricultural plant products for food markets. In this line, the agrifood system includes all aspects of production, supply,

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[28] Kızılaslan, N., & Dağdelen, K. (2023). Genç Çiftçi Projesinin Sürdürülebilirliğinin İncelenmesi: Tokat İli Turhal İlçesi Örneği. Gaziosmanpaşa Bilimsel Araştırma Dergisi, 12(2), 182-196.
[29] Karsak, B. (2024). Between 'moral economy'and 'social banditry': harvest theft in a peasant community. The Journal of Peasant Studies, 51(2), 512-532.
[30] Dunford, R. (2017). Peasant activism and the rise of food sovereignty: Decolonising and democratising norm diffusion? European Journal of International Relations, 23(1), 145-167. https://doi.org/10.1177/1354066115614382
[31] Ziegler, J. (2003, October 31). *The right to food :report : addendum /*. Retrieved from https://digitallibrary.un.org/record/506617/files/E_CN.4_2004_10_Add.2-AR.pdf
[32] Louis, E. (2015). "We Plant Only Cotton to Maximize Our Earnings": The Paradox of Food Sovereignty in Rural Telengana, India. The Professional Geographer, 67(4), 586-594.
[33] Timmermann, C., & Robaey, Z. (2016). Agrobiodiversity under different property regimes. Journal of Agricultural and Environmental Ethics, 29, 285-303.
[34] Mühlenhoff, S. C. (2021, October 26). Financial inclusion in the Global South: An analysis of index-based agricultural insurance and Farmer Food Security in India. KOBRA. https://kobra.uni-kassel.de/handle/123456789/13325
[35] https://www.fao.org/evaluation/highlights/agri-food-systems/en, 07-Sep-2024

storage, distribution and waste management facilities. In short, food processing and marketing that connect agricultural food products from producers to final consumers. Notably, waste management is a part of the agrifood system, however, it has been left out of the scope of this paper.

Alternative food network (AFNs) are community-driven movements that are built with a bottom-up approach[36] (Barbera & Dagnes, 2016). In opposition to the commercialized agrifood system, AFNs aim to bridge the producer to the consumer via independently and locally organized short food networks. In this way, farmer members of AFNs can act collectively for conducting logistic steps such as storage, processing, distribution, and sale of agrifood products. In practice, collectives and cooperatives are the institutional bodies that aim to achieve such food networks. By establishing AFNs, consumer can buy directly from farmers via directs sales or from community led intermediaries, therefore the farmers can become more resilient against cases of personal powerlessness in the absence of industrial facilities.

Additionally, AFNs can incorporate farmer education and social security benefits in their structure[37] (Tüzün & Aydoğdu, 2019). In this way, local producers can cooperate with each other for indigenous agroecological practices as an alternative to agricultural biotechnology practices provided by multinational enterprises. As a result, seed networks, and cultural practices of making fertilizers and pesticides can become possible to integrate for enhancing local knowledge on land and water protection. In the financial sector, it has been shown that members of the farmer cooperatives have a better chance to receive financial credit and can become a part of the social security system provided by their cooperative.

Methodology

Composite Indices

Composite indices are tools to measure a social phenomenon in a defined boundary for supporting and measuring social policy decisions. The method consists of combining multiple indicators that are relevant to the situation and then processing them in a relational manner to create an overall understanding[38] (Chand, 2019). A composite index, in other words, is an aggregation method for considering multiple indicators in different topics that are responsible for a social outcome. As a result, the analysis focalization will become possible to be compared in different regions on the same basis, either by the total index point or category points of the index. The six main steps to develop a composite index are: Selecting variables, imputation of missing data, multivariate analysis, normalization of data, weighing and

[36] Barbera, F., & Dagnes, J. (2016). Building alternatives from the bottom-up: the case of alternative food networks. *Agriculture and agricultural science procedia*, *8*, 324-331.
[37] Tüzün Rad, S., & Aydoğdu, C. (2019). Tarımsal Finansman: Mersin İlinde Tarımsal Kredi Kullanımı. Tarım Ekonomisi Araştırmaları Dergisi, 5(2), 58-67.
[38] Chand, P. Construction of Composite Index. Chapter 33, p.351-360, in Vinayak Nikam, A. J. (2019). Quantitative Methods for Social Science. New Delhi: ICAR - National Institute of Agricultural Economics and Policy Research.

aggregation, and robustness and sensitivity analysis[39] (OECD, 2008). Except for the first stage, selection of variables, all the steps involve statistical consideration of the data. In general, statistical consideration requires the extensive application of selected variables in all possible statistical equations. As a result, analysis choices might provide equally viable results for different analytical expectations[40] (Baktybekova, 2024).

Composite indices are used for a variety of reasons[41] (Manikas et al., 2023). Firstly, interpreting single metrics such as national metrics of income per capita or agricultural production per capita would lack the sensitivity for understanding disparities between different regions and income quartiles. For this reason, issues such as life quality or nutritional intake sufficiency require an in-depth look with carefully identified indicator combinations. Even so, household level data is a difficult to access on these terms. Secondly, while multiple indicators are affecting a social phenomenon, composite indices facilitate assessing vulnerabilities between different focus groups. Lastly, composite indices are easy to communicate between different areas and levels of expertise, which makes them a viable tool for scientific collaboration.

On the other hand, composite indices limitations and requires updates. Limitations arise from indicator selection, data quality, and data processing methods. Construction of a composite index, therefore, is limited by available data and subject to alternative interpretations in weighting and aggregating indicators altogether[42] (Ruiz-Almeida & Rivera-Ferre, 2019).

Consequently, the good performance of an indicator may substitute the bad performance of another indicator, which in return arrives at the same point with concealed vulnerabilities. A similar problem arises when there are group-wise differences in the collinearity of separate indicators. Moreover, including categorical data in a continuous composite index necessitates defining threshold values, which are subject to researcher preferences. In summary, there are trade-offs between predictive capacity and comprehensive complexity in the construction of a composite index[43] (Chen et al., 2021).

Variable Selection Method

Variable selection is the core of building a composite index. Usually, this process is done by experts' opinions considering the suitability and availability of data. In my research, I employed a variable extraction method by recording all variables mentioned in 32

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[39] OECD, European Union, & Joint Research Centre - European Commission. (2008). Handbook on Constructing Composite Indicators: Methodology and User Guide. OECD. https://doi.org/10.1787/9789264043466-en

[40] Baktybekova, Z. (2024). Constructing a composite indicator to measure quality of life in the selected region [Master's thesis, Czech University of Life Sciences Prague, Faculty of Economics and Management]. https://theses.cz/id/7gev2g/

[41] Manikas, I., Ali, B. M., & Sundarakani, B. (2023). A systematic literature review of indicators measuring food security. Agriculture & food security, 12(1), 10.

[42] Ruiz-Almeida, A., & Rivera-Ferre, M. G. (2019). Internationally-based indicators to measure Agri-food systems sustainability using food sovereignty as a conceptual framework. Food Security, 11(6), 1321-1337.

[43] Kaiser, M., Chen, A. T. Y., & Gluckman, P. (2021). Should policy makers trust composite indices? A commentary on the pitfalls of inappropriate indices for policy formation. Health research policy and systems, 19, 1-11.

Türkiye-based research papers. The list consists of articles found in Dergipark[44] with keywords “tarımsal” (agricultural) and “kırsal” (rural), with one additional article on “agroekoloji” (agroecology) and one on social welfare policies. Consequently, the final variable list includes more than 100 variables from nearly 20 defined categories. The final variable list is defined by the Turkish National Statistical Institute’s (TÜİK) availability. For the scope of my research, simplification is used for crop types and land uses.

Data Sources

The data is collected from national and foreign sources. The major part of the data, which includes economic and social variables regarding agrifood systems, is gathered from TÜİK. The data has city-level details for production volume, land use, and demographics. Geographic information will be only considered in hectares, and detailed satellite imagery is left out of the scope due to computational requirements.

In addition to geographical and socio-economic variables, food security and food sovereignty theories comprise governmental support for regional farmer resilience and sustainability of agriculture. In Global Food Security Index (GFSI)[45], the policy support is ordinally indicated with 0-2 for the existence of policies. However, in Türkiye, policy support is fragmented by selected regions and crop types. From year to year basis, the coverage has gradually expanded for more cities. Yet, financial support analysis will require analysis of global price fluctuations due to currency exchange ratios. For this reason, the Official Gazette of the Republic of Türkiye is used for comparison of national index scores along with published legislations.

Results

Official Gazette

For the analysis of the Official Gazette of the Republic of Türkiye, web scraping methods were employed to gather information about the titles and their content. There were two types of issue formats found on the official website. For the issues from 2000-June-27, there were portable document format (PDF) and hypertext markup language (HTM). The earlier versions are all in PDF. Since PDF is computationally intensive for natural language processing, HTML-formatted issues are compiled. This is because PDF format were not readily text processing available, and optical character recognition (OCR) is needed to be used. For this reason, in-text level understanding is left out of the scope of this research.

In HTML format (which was acquired with .htm link structure) daily titles’ content is stored in hyperlink text format with PDF. For filtering relevant legislations, regulations, and notifications, the Official Gazette titles are stored in Excel documents with their corresponding metadata. In the initial part, the keyword “agriculture” (tarım) is used to

[44] https://dergipark.org.tr/tr/

[45] https://impact.economist.com/sustainability/project/food-security-index/resources/Economist_Impact_GFSI_2022_Global_Report_Sep_2022.pdf

collect relevant titles. In the result, 2398 entries were collected for the dates between 27-June-2000 and 7-June-2024.

Upon preexamination with TFIDF clustering, the silhouette score metric is used for the evaluation of performance. Between 10 and 180 number of cluster, a maximum of 0.30 silhouette score is achieved with 180 clusters. In an efficiency with the elbow method, the choice of 50 cluster is seemed to be applicable with a silhouette score of 0.20.

Since clustering did not yield the desired results, manual annotation is applied to create a corpus for eliminating irrelevant topics with the NLP prediction model. For this step, cross-validation is used using two manually annotated batches of 20% (479) and 16% (384) in total filtered titles. Firstly, I annotated the first batch of 20% for recording relevant topics. Among the irrelevant ones, there were decisions of appointment for ministries, institutional regulations, and secondment notifications for ministries. Later, the second batch is predicted with NLP for capturing relevant topics using the first batch. After the manual validation of the second batch, accuracy scores 95.62% for the first and 96.61% for the second batch have been achieved. In the last phase, the two batches together have been used to predict the remaining 1241 titles.

Upon the last prediction, the next phase acquired 546 relevant titles which are further classified into agreements and support policies. Then, a final classification is applied to understand the context in detail. This section presents the subtopics of the Official Gazette of the Republic of Türkiye about agricultural topics. In the result, there were 266 entries on topics related to international issues and 280 entries on topics related to domestic policies.

Agreements and International Support

There are siz topics on international subjects which are: Import tariff quotas (tarie kontenjanı), collaborations (işibirliği),concession (taviz), patnership (ortaklık), IPARD and IFAD policies, chemical fertilizers (kimyevi gübre), and import rules (ithalat esasları).

Titles on quotas were about import tax reduction for a country or a group of countries regarding goods from processed or non-processed agricultural food and livestock. Articles about collaboration mention a form of empowerment agreement about technical or managerial collaboration. Issues on concession indicate a mutual import-export benefit agreement with the mentioned countries. IPARD (Instrument for pre-accession assistance for rural development) policies are related to the European Union’s financial support for rural development for potential candidate countries. IFAD policies are also financial support for rural development, but it is funded by United Nations. Titles about chemical fertilizers were last published in 2002, and they govern the rule about provision. Import rules govern the control and inspection of imported goods in mentioned countries.

In the findings, there are 161 entries for import quotas, 80 entries for collaborations, 9 entries for concession, 1 entry for partnership, 7 entries for IPARD and IFAD policies, 3 entries for chemical fertilizers and 4 entries for import rules.

Support Policies

The annotation process yielded 29 topics in total, based on keywords. Among them 7 main topics were identified with subjective evaluation. In the results, there are 8 entries for general law, 76 entries for farmer support, 48 entries for investment support, 46 entries for financial support, 4 entries for retraction of support, 42 entries for sale, consultancy and storage support, 17 entries for loss and damage support.

General Law

There are 2 agricultural law (tarım kanunu), 1 local governorship verdict (valilik kararı), 2 genetic sources (genetic kaynaklar), 1 contracted agricultural product rules (sözleşmeli tarımsal ürün esasları), 1 land division, legacy (arazi paylaşımı, miras), 1 export notification (ihracat tebliği).

Farmer Support – Direct, Land, Product, Input, and Data Network Participation

There are 21 support (destekleme), direct income support (doğrudan gelir desteği), 15 agricultural land protection support (arazi koruma desteği), 6 fuel and fertilizer support (mazot ve gübre desteği), 1 land activation (arazi kullanım etkinleştirilmesi), 2 irrigation and energy support (sulama desteği, enerji desteği), 12 farmer accounting data network participation support (çiftlik muhasebe veri ağı katılım desteği), 11 deficiency payment (fark ödemesi), 7 good agricultural practices support (iyi tarım desteklemesi), 2 social support payment (sosyal destek ödemesi) titles.

Investment Support

There are 11 agricultural economic investment (tarıma dayalı ekonomik yatırım), 17 rural development support (kırsal kalkınma destekleri) titles.

Financial

There are 44 tax rate reductions (kredi faiz indirimi), and 2 financial support with treasury dividend (hazine kar payı destekli finansman) titles.

Negative

There are 9 support cancellation due to debt (borç sebebiyle destekleme iptali), 7 insurance premium deduction (sigorta prim kesilmesi), 1 support interruption (destekleme kesintisi) titles.

Sale, Consultancy, Storage

There are 16 agricultural publication and consultation support (tarım yayın ve danışmanlık desteği), 13 licenced warehouse support (lisanslı depoculuk desteği), 13 cooperative sale support (kooperatif satış desteği) titles.

Loss and Damage Support

There are 15 debt postponement and disaster support (borç erteleme, doğal afet ve terör hasar desteği), 23 export refund support (ihracat iadesi desteği), 2 surplus purchase by government (arz fazlası devlet alımı) titles.

National Agricultural Statistical Data

For the creation of the index and performing analysis, city-level indicators have been gathered via Turkish Statistical Institute (TÜİK) covering the years 2008, 2010, 2012, 2014, 2016, and 2018. Initially, 184 indicators were recorded from research papers about Türkiye. After manual check regarding data intersectionality and accessibility, the final list contained 24 indicators with sub-level data. Among them, foreign data sources were eliminated such as NASA and AQUASTAT because of irregularities. The data with NUTS2 level is as well dropped from the final list. The data from Türkiye Ministry of Agriculture and Forestry (Tarım ve Orman Bakanlığı) is detected to have agricultural technic nuances, and therefore all city-level indicators are sourced by TÜİK, except city surface area data which is sourced by General Directorate of Mapping (HGM) of Türkiye.

To confine understandability and generalizability, crop type analysis is summed up to total production. Epistemologically, food security index was focusing on market variables. Therefore, household surveys were focused for understanding the nutritional situation. However, in the long term, where domestic production and consumption meet remains ambiguous. Therefore, it has to be understood that there is a distinction between domestic production and supply. The reason is that, although food sovereignty focuses on local production measures, the theory misses the logistical properties of local production.

In reception of variables, I initially marked twenty-seven variable categories that are land use, governance, ecology, market, household, rural development, crop type, costs, finance, demography, water, land security, autonomy, regional, network, agroecology, scale, spatial, tech capital, food sovereignty, cooperative, husbandry, seed sovereignty, farmer dynamics, ethnicity, gender, and income. For these variable categories, I derived nine general categories for analysis that are economic conditions, ecological conditions, land use, policies, rural development, rural life, agricultural diversity, agricultural ownership, and agricultural development.

Food sovereignty theory focuses on productive capacity for the communities and land. Therefore, mean household count and total city area are regarded as denominators for intensity. The agricultural productions nominal value, is divided by end-year's exchange rate taken from Central Bank of the Republic of Türkiye[46] (TCMB).

Finally, after conducting TÜİK research, the paper included fifteen variables sixteen variables for each city in six different year data points. Variables are: total population, total city area (km2), agricultural production per 1000USD, mean household size, land use as harvested area (hectare), land use as greenhouse agriculture (decare), land use as sowed area (hectare), land use as fallow area (hectare), land use as vegetable area (hectare), land use as long term crops area (hectare), production of greenhouse (ton), production of total agriculture (ton), water refined (1000m3), water drainage (1000m3), electricity energy use (MWh), waste collection (1000ton). After mathematical transformations, the analysis take two denominators: Per household value and per land area value for each city.

[46] https://www.tcmb.gov.tr/kurlar/kurlar_tr.html

In summary, there are six categories for theoretical interpretation: Market, production, water use, waste management, energy use, and land use.

Categories

Market

In market category, there exist agricultural production in monetary value.

Production

In production category, there exist production of soil-based agriculture and greenhouse-based agriculture in tons.

Water

In water category, there is drainage and refined water use in 1000m3.

Waste

In waste category, there is waste collected in 1000ton.

Energy

In energy category, there is electricity use in MWh used in agriculture.

Land Use

In land use category, there are six types of uses. These are, harvested area, sowed area, fallow area, vegetable area, greenhouse area, and long-term crop area.

In the analysis, three groups are taken for metropolitan status: new-metropolitan cities (2012 Law 6360 effected cities), old-metropolitan cities and non-metropolitan cities. Since the law was accepted in 2012 and put into effect in 2014, the year 2013 is chosen as the cut-off point. In composite index methodology, min-max scaling and summing up methods are used.

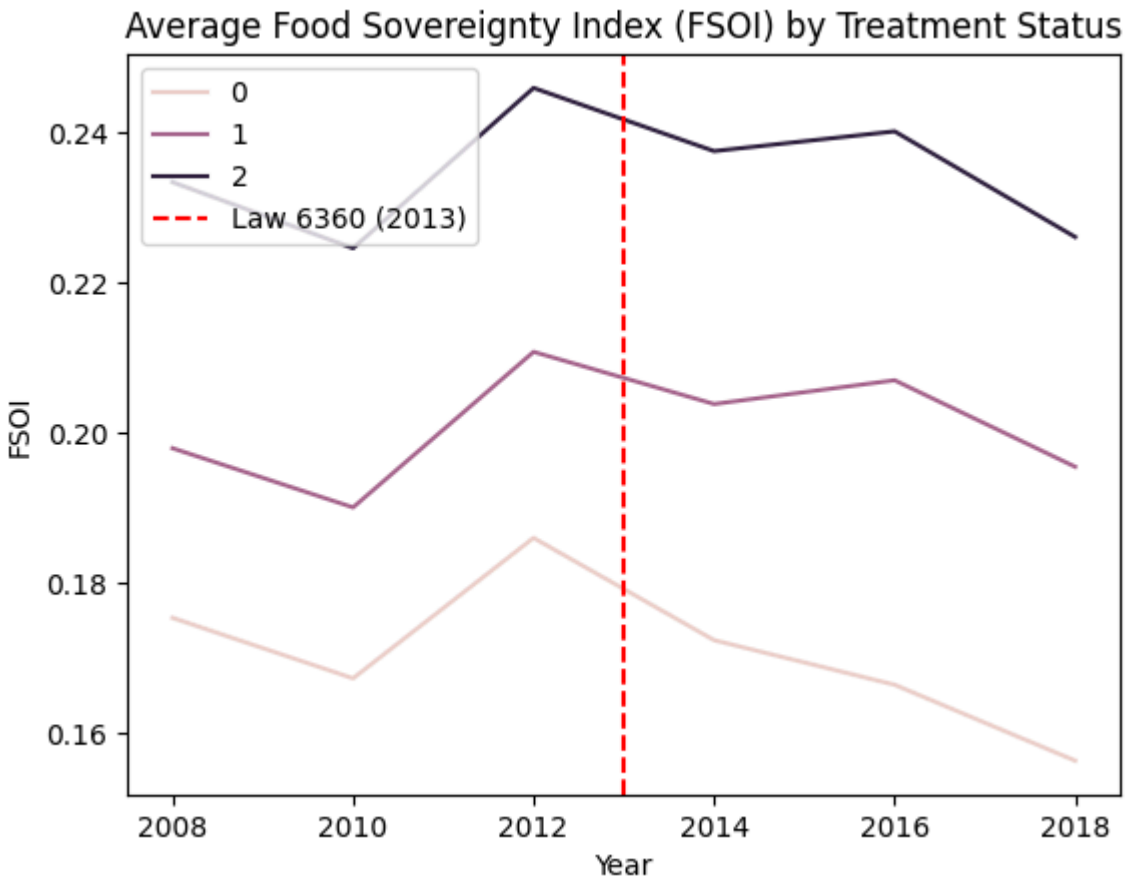

Figure 1 : Non-Metropolitan Cities (0), New-Metropolitan Cities (1), Old-Metropolitan Cities (2)

The graph here represents a parallel distribution among all city groups in Türkiye. It can be concluded that Law 6360 on its own has no direct effect on food sovereignty. Starting from 2012, all groups tend to lower in food sovereignty index points. As a result, Türkiye shows weakening of domestic food production per denominator, regarding its land or output in use for agriculture. An additional inference also shows that metropolitan cities have a greater food sovereignty point, therefore, the greatness of a city correlates with domestic food production per land and per household values.

Statistical significance analysis supports the claim that Law 6360 alone did not alter food sovereignty status. Using ANOVA analysis on a yearly basis, p-value resulted in 0.43. Using T-test for pre and post treatment, p-value resulted in 0.35. Because the p-value should be lower than 0.05, the results conclude that Law 6360 has not a direct effect on new metropolitan cities. Yet, many external factors are effective in an open market economy.

Lastly, the variables are presented here to show the weight they carry in the creation of the food sovereignty index. It is helpful to understand how these variables interact with the index for reevaluating the theoretical basis.

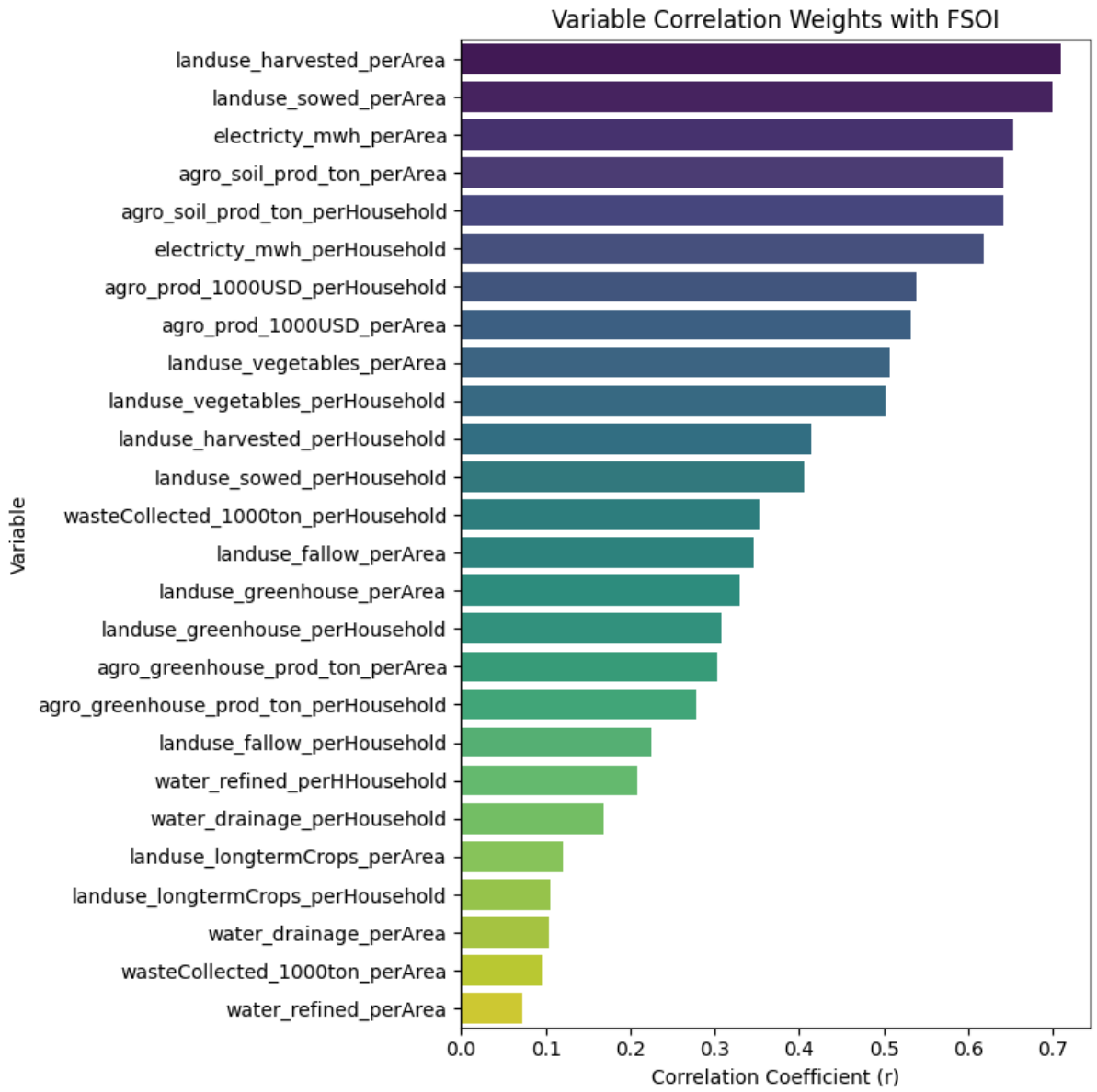

Figure 2 Variable Correlation Weights with Food Sovereignty Index

In summary, categories water and waste are shown to have lower weight on the calculation of food sovereignty index. The distinction to be drawn here is that agricultural water and waste management is not heavily affected by sovereignty status. Water and waste management is generally carried in all potential by municipalities, therefore there is not a distinction of agricultural sufficiency regarding these facilities. However, Law 6360 critics also presented that the new governance model tends to increase infrastructure costs for agriculture and therefore may negatively affect the food sovereignty for local people. The difference of this argument is not inferrable from this study, because household level surveys are not carried out by different enterprise scales. Land use intensity and per household share variables are shown to be correlated with FSOI weighting, as the baseline theory suggests from the literature reviews.

Discussions

The food sovereignty index in this research is first of its kind. The existing food sovereignty indexes are focusing on national measures[47] (Mansouri, 2023), and the topic is still in development. Taking a view outside of food security increases how small-scale production areas behave under global market conditions. This is, in part, useful for reducing carbon emissions by organizing food trade among accessible regional units. Logistic shocks, such as Coronavirus Pandemic showed that global transportation networks are fragile. Therefore, export oriented agrifood systems would put local people in danger due to monoculture farming. For this reason, resilience of wellbeing and ownership of production indicates the accessibility to shelves from consumers in a relatively short path.

Academic research tends to have three directions in quantitative meaning, these are exploration, description, and causation. In this paper, it showed that Law 6360 affected Türkiye, however, treated cities did not differ from untreated cities. As a result, it has been inferred that, Türkiye as a whole facing a loss of agricultural sovereignty after the iteration of Metropolitan Law. In global conditions, devaluation of Turkish Lira presented a precarious analysis point in agricultural sovereignty. In general, here we can conclude that the loss of agricultural sovereignty is not related to the Law 6360, but it is a national phenomenon regardless of the new governance model.

Limitations

For the application of the Food Sovereignty Index, I selected Law 6360, the 2012 Metropolitan Law (Büyükşehir Yasası), which affected the governance status of villages in 14 new cities by changing inclusion criteria to be a metropolitan city. The indicators are chosen by relying on social research articles from Dergipark (Türkiye's national research journal database) which focuses on Türkiye as area that contains agricultural (tarımsal) and/or rural (kırsal) in their title. In the final, there were 32 papers as expert opinion sources for creating the socio-economic index frame. Since the research has been done without local surveys, data accessibility is limited by centrally published socio-statistical data. In further research, cooperative surveys is suggested to understand indigenous reception of national legislations.

There were two issues with the NLP application in the Official Gazette of the Republic of Türkiye. Firstly, automate clustering of titles would not yield the desired results for separating topics. Certain keywords such as insurance and debt indicated both positive and negative connotations to the agricultural economy. Secondly, the main body of the official gazette issues was not readily processed in text format. Therefore, due to the complexity of the text layout, context extraction has been left out of the scope of this research. As a result, there is no information about the detailed budget report for the support of agricultural production.

About missing data consideration, seed sovereignty and input sovereignty could not be included. Farmer choices of seed types, pesticide and fertilizer selection remain a niche area

[47] Mansouri, A. (2023, July). *Designing indicators for monitoring the food sovereignty*. In 64th ISI World Statistics Congress.
https://www.isi-next.org/media/abstracts/ottawa-2023_7916dbd8953f160dca34ae94852070eb.pdf

to interpret due to irregularities between crop type uses. There are initiatives to nationalize seed and input production by Ministry of Agriculture and Forestry of the Republic of Türkiye (T.C. TOB), therefore, in the future research it would be possible to consider an expanded version of food sovereignty.

Conclusion

The paper aims to reveal agricultural governance policies and their effects on food sovereignty. To achieve this, the Official Gazette issuance analysis and official statistical data analysis is conducted. The theory of sovereignty indicates the production of agricultural goods by domestic means. Therefore, city level analysis needed to be at the center of focus in agrifood metrics. In the hypothesis, it has been expected that the Law 6360 will negatively effect the food sovereignty status in treated cities. However, it has been found that Türkiye in general has a loss of food sovereignty after the Law 6360. In sum, the paper can not conclude that Law 6360 alone had an impact on the loss of food sovereignty in Türkiye. To summarize, here the Food Sovereignty Index is presented by selecting variables from area studies, and the first pillar to analyze domestic self sufficiency is provided with this research.