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Determination of optimum agricultural policy for buffalo breeding

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ABSTRACT - The present study aimed to determine the optimum agricultural policy components for buffalo breeding respecting the welfare of breeders. The data used for the study was composed of microdata retrieved from buffalo breeders in Turkish provinces, where buffalo breeding is widespread. The data retrieved via face to face survey was analyzed and interpreted with descriptive statistics and Conjoint Analysis, which is one of the multivariate analysis techniques. In this study, we investigated and discussed the scope of supporting policies provided to buffalo breeders to promote buffalo breeding and to assure its sustainability. Besides, this research is a preliminary and innovative study that intended to focus on breeders' utility in the evaluation of supports provided to buffalo breeding. According to the findings, the most critical factor for buffalo breeders in terms of producer-oriented policy framework appeared as "subsidy in cash paid per head" (32.10%), which was followed by "investment support" with 21.25%. In addition to these tools, "marketing support" (16.51%), "product support" (16.18%), and "investment credit" (13.96%) appeared as essential and vital policy tools.

Keywords: buffalo, Conjoint Analysis, policy preference, Turkey

1. Introduction

Animal products are used in various sectors, such as clothing and transportation, in addition to nutrition. Accordingly, it is vital to achieve continuity of the sector. Supporting policies and tools provided by governments are dominant and determinative for the sustainability of the sector globally. The main objectives of supporting systems are granting sufficient nutrition of the society via self-sufficiency of the industry, rising enterprise-level efficiency and producer income, and rural development (SPO, 2006). In this respect, governments do focus on supporting policies to develop animal husbandry and receive advantages in foreign trade. There are many tools used to promote animal breeding. As animal breeding does not demonstrate continuity and reaching targeted objectives is costly, the success of supportive actions is limited when compared with vegetative production (Yavuz, 1999).

The most significant revision in supporting policies resides on conversion from a top-bottom approach in developing strategy and tools to a bottom-top approach and respecting the needs and welfare of breeders. The reason is that the sustainability of the sector and achieving efficiency in resource utilization are based on keeping breeders in the industry. Thus, breeders should get the maximum

2

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

benefit from supporting policy and tools, and it is vital to determine relevant factors that would satisfy breeders (Demir and Yavuz, 2010).

When buffalo breeding is explicitly considered, it should be noted that it has been maintained in 34 countries around the world and constitutes a niche market. There are 217.8 million heads of buffaloes in the world with a rising trend. India ranks the first in buffalo breeding with a share of 50.5%, and Pakistan and China follow it. While the percentage of Turkey is so limited with 0.06%, it is intended to develop buffalo breeding there (FAOSTAT, 2020).

Buffalo meat is valuable within the market of animal products. Besides, buffalo milk has 11-30% more protein and 10% more mineral content than cow milk. With 7-9% more fat ratio, buffalo milk is valuable for the food industry as well (Soysal, 2006; Soysal, 2009).

When the international literature on the subject is overviewed, it is seen that the focus is on buffalo breeding. However, to our knowledge, there is a limited number of studies examining the economic aspect of buffalo breeding. When the scope of this research is considered, there is no study involving policy implementations for the development of buffalo breeding activity. Besides, the focus of our study on policy component analysis to determine policy tools for breeder welfare maximization with conjoint technique is considered as innovative. Therefore, we aimed to determine the efficient agricultural policy components that maximize the welfare of buffalo breeders with a sample from Turkey.

2. Material and Methods

The primary data used in the study were retrieved from surveys conducted in Samsun, Istanbul, Diyarbakir, Mus, Tokat, Bitlis, and Afyonkarahisar provinces of Turkey in 2014.

The selected provinces provide 57% of buffalo meat and 56% of buffalo milk supplied in Turkey. In the sampling process, data retrieved from HAYBIS and databases of provincial and town directorates of the Ministry of Agriculture and Forestry were used. The sample size was determined as 462 (Table 1) (Cicek and Erkan, 1996).

$$n = \frac{(\sum N_h S_h)^2}{N^2 D^2 + \sum N_h S_h^2} \tag{1}$$

in which n = sample size, N = total number of units, N_h = number of units in the target layer, S_h = standard deviation in the target layer, D = d/z [d: presumed deviation (5%), z: standard normal distribution value (95%)], and S_h^2 = variance of the layer (1).

The layers were determined due to the size of farms respecting the number of buffalos owned (Table 1).

Conjoint Analysis, a multivariate analysis technique, was used in the research following the demonstration of descriptive characteristics of the sample. Conjoint analysis can be described as a systematic evaluation and estimation of a decision made by the respondent among a restricted number of alternatives (Hay, 2002). This method aims to determine the characteristics and mostly expected attributes of an existing or newly developed service. The main objective is to identify priorities and alternatives that affect the expected decision (Schweikl, 1985). The first step of the analysis is to select the preferential function to be used in the estimation of the factors affecting the decision. This function

Table 1 - Number of buffalo breeders concerning target provinces

No. of buffaloes	Samsun	Istanbul	Diyarbakir	Tokat	Bitlis	Afyon	Mus	Total
1-5	13	6	22	7	15	8	8	79
6-15	24	8	20	22	23	15	14	126
16-35	23	17	5	15	10	20	10	100
36-+	46	38	9	16	6	20	22	157
Total	106	69	56	60	54	63	54	462

is a basis to determine partial values of factor characteristics affecting individuals' decisions (Gutsche, 1995; Green and Srinivasan, 1978).

With this method, it is assumed that the value of a service attributed by individuals is the sum of total utility retrieved from the service (Sonmez, 2001). Utility, on the other hand, is a personal assessment and can be partly quantified by conjoint analysis. The conjoint analysis depends on "Total Utility Theory". Partial utility of characteristics of a service composes total utility when summed up (Ness, 2002).

Selection of the factors and their layers inserted in the cards to be demonstrated to participants is a rather crucial step in the scope of conjoint analysis. Factors should be determinative in affecting the individual's selection, should include complete and meaningful information on the service, a should also be realistic and interpretable. Also, a rising number of factors or factor layers would lead an increasing number of parameters and cards to be demonstrated, which would lead to loss of parameter validity (Hair et al., 1995). The policy set maximizing the utility of breeders and the effectiveness of policy tools affecting breeders in this selection process was determined in the scope of the analysis.

Previous literature on buffalo breeding mostly focused on buffalo economics, and research on marketing and supporting policies are limited in number. Some of this research was overviewed. Soysal et al. (2005) set forward economic and social conditions of buffalo breeders operating in Danamandıra village of Silivri, Istanbul. They focused on the motivation behind buffalo breeding and problems encountered in the breeding process. Borghese (2005) focused on the buffalo population and breeding and marketing strategies around the world. Sheikh et al. (2006) recognized a 13% rise in the buffalo population between 1975 and 2000 in the Amazon region of Brazil, which was the highest multiplication ratio. Al-Obaidi et al. (2007) utilized data retrieved from three southern provinces of Iraq (Thi Qar, Meysan, and Basra) to note buffalo breeding strategies maintained. Atasever and Erdem (2008) focused on reasons in diminishing buffalo population in the scope of contemporary intensive breeding conditions. They set forward structural features of buffalo breeding in Turkey concerning its problems and future perspectives. Cicek et al. (2009) analyzed resource use efficiency in buffalo breeder farms via Cobb-Douglas production function. Sariozkan (2011) focused on the progress in buffalo breeding in Turkey between 1970 and 2008. The declination in production of meat, milk, and skin had appeared as problematic issues in buffalo breeding. Sahin and Yildirim (2012) emphasized the importance of buffalo breeding under extensive conditions for rising productivity. Sahin et al. (2013) suggested the development of organic buffalo breeding as an alternative profitable animal breeding field. Albayrak et al. (2012) indicated the importance of buffalo breeding economically for Samsun province of Turkey. Canbolat (2011) emphasized the declination in meat, milk, and skin production due to the declining number of buffalos. It was set forward that new approaches and specific supporting programs are essential to develop buffalo breeding. Cruz (2013) emphasized the declining share of swamp buffalos due to enlargement of vegetative production in East and South Asian countries. Cruz indicated the need to develop strategies and use supporting mechanisms for rising meat, milk, and skin products for the sake of relevant industries. Sweers et al. (2014) studied the economic potential of buffalo breeding in Germany concerning feeding, breeding, and marketing strategy development. Isik and Gul (2016) calculated the production cost of buffalo farms in Mus province of Turkey. They found that the farmers' relative profit was higher than 1.

Subsequently, we decided to use Conjoint Analysis to determine the supporting policy component specific to the buffalo breeders, which appeared as a differentiating analysis concerning the previous literature visited.

Conjoint Analysis is used in designing a new product that maximizes the producer/consumer benefit and determining the preferences of individuals. This analysis technique was used within this study because the buffalo breeders, who constitute the target group of this study, have agricultural support policy preferences.

One of the essential phases of conjoint analysis is to determine the preferential ranking between factors and factor layers. In this step, it is vital to decide on them. Researchers asked breeders to assess

4

Determination of optimum agricultural policy for buffalo breeding
Taşcıoğlu et al.

the previous and existing supporting tools with a pre-implementation survey, and the elements and attributed layers were determined (Table 2).

The factors and layers were inserted in the SPSS statistical package, and preferential cards were designed orthogonally (Table 2). Twenty combinations were determined in SPSS. Accordingly, survey participants were asked to scale 20 alternative combinations from 1 to 10 for all, 1 referring to the most preferred option. Concerning the selection made by each breeder, the significance of factors, partial utility value of each element, and scaling score were computed via Bretton-Clark Conjoint Designer.

The findings of the conjoint analysis, whose details were explained below, were expected to contribute determination of the optimum policy mix for maintenance and development of buffalo breeding in Turkey.

3. Results

Determination of the existing situation of breeders, their needs, wants, and expectations and satisfaction of these in a utility-maximizing manner are significant components of the breeder and production-oriented agricultural policies. With this respect, some critical characteristics of buffalo breeding farms and that of breeders were considered in the study. The abundance of buffalos in farms appeared as an essential characteristic, and farms were grouped into four (Table 3).

Table 2 - Factors and factor layers used in Conjoint Analysis

Factor	Factor layer
Investment support (IS)	50% grant – two years non-refund (IS1)
	75% grant – two years non-refund (IS2)
	25% grant – five years non-refund (IS3)
Investment credit (IC)	Without interest – three months delay (IC1)
	Without interest – no delay (IC2)
	Low-interest rate – six months (IC3)
Animal support (AS)	500 TL ($ 72.89) up to 50 heads, 300 TL ($ 43.73) for 51-100 heads, 200 TL ($ 29.15) for 101-250 heads, 100 TL ($ 14.58) for 251 and more heads and three years (AS1)
	800 TL ($ 116.62) up to 50 heads, 600 TL ($ 87.46) for 51-100 heads, 400 TL ($ 58.31) for 101-250 heads, 200 TL ($ 29.15) for 251 and more heads and for once (AS2)
	400 TL ($ 58.31) up to 500 heads, 200 TL ($29.15) for 501 and more heads and for once (AS3)
Product support (PS)	0.2 TL/L ($ 0.03/L) milk; 1 TL/kg ($ 0.15/kg) meat support (PS1)
	0.2 TL/L ($ 0.03/L) milk; no meat support (PS2)
	0.4 TL/L ($ 0.06/L) milk; 0.5 TL/kg ($ 0.07/kg) meat support (PS3)
Marketing support (MS)	Existent (MS1)
	Inexistent (MS2)

(1$ = 6.86 TL)

Table 3 - Groups of buffalo breeders

No. of buffaloes (head)	No. of the group	N	%
1-5	I	79	17.10
6-15	II	126	27.27
16-35	III	100	21.65
36-+	IV	157	33.98
Total		462	100.00

5

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

Some characteristics of breeders such as age, breeding experience, and education level were provided. Breeders were 47 years old on average, and most of them completed at least the primary education (Figure 1).

The highest education duration was detected in the second group, with 6.39 years on average. There is no significant difference between groups in terms of education level, and most of them did not get through high school education. Considering their average age as 47 years, they were highly experienced with almost 30 years of experience in farming and 29 years in animal breeding. The first group of breeders seemed to have more experience referring to small scale domination. When buffalo breeding experience was considered, the average declined to around 25 years, and the third group appeared as the most experienced group.

Turkey's traditional characteristics affect agriculture, which is the dominant economic sector, for historical reasons. Due to the population it employs and feeds and self-sustainability and competitive requirements, agriculture needs to be supported with different tools. With supporting policy and tools, it was aimed to provide income compensation to agriculture sector participants. Supports provided to animal breeding are accordingly essential and refers to maintenance and development of the activity, sustainable supply of animal products for national consumption with securing national genetic resources.

Concerning buffalo breeding, the main objectives are to secure the development of the the local genetic source and sustainably increase production.

The supporting tools used for buffalo breeding are as follows: 350 Turkish Lira (TL) ($ 51.02) per head of calves and baby calves above four months old; 500 TL ($ 72.89) per registered calf and 400 TL ($ 58.31) for baby calves, if programmed vaccination of the previous year was made; 50 TL ($ 7.29) per head additionally to new-born calves of genetically controlled local Taurus or calves born from embryo
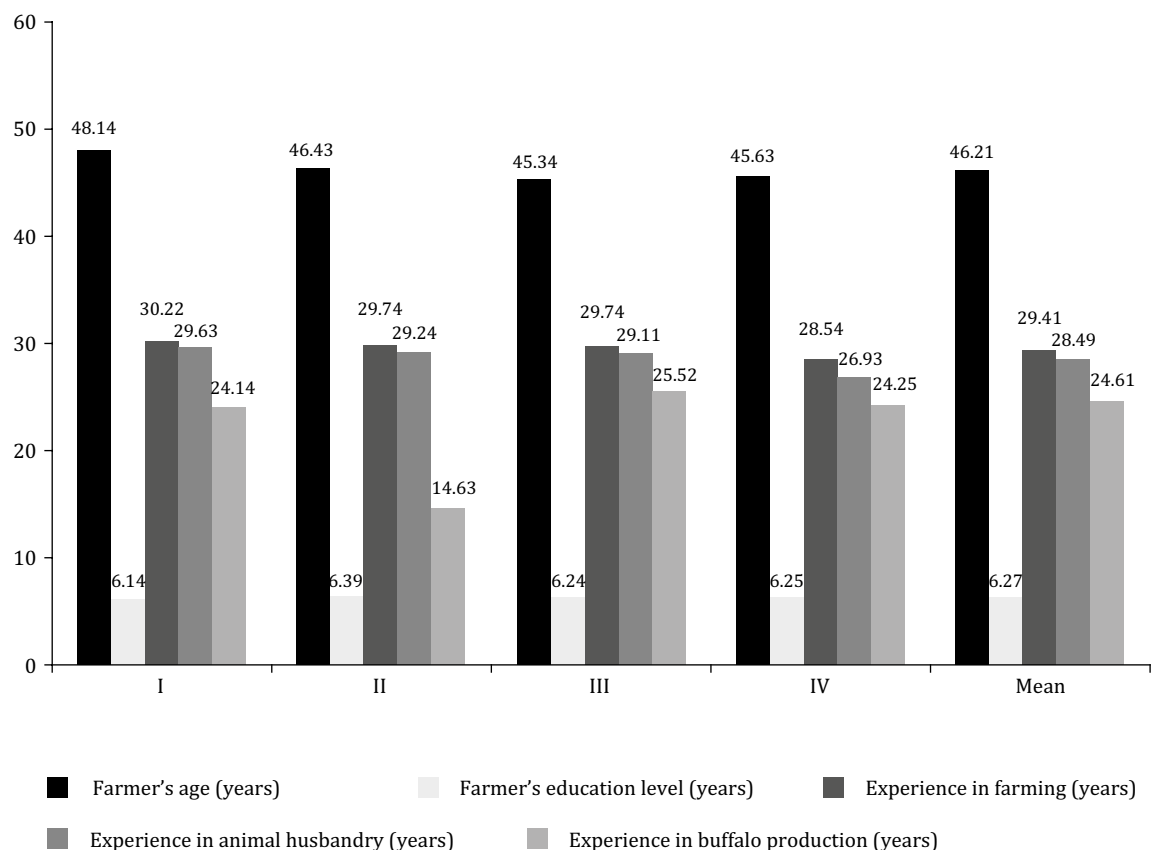

Figure 1 - Characteristics of buffalo breeders.

6

Determination of optimum agricultural policy for buffalo breeding
Taşcıoğlu et al.

permitted by the Ministry; 250 TL ($ 36.44) per rootstock buffalo and 400 TL ($ 58.31) per registered rootstock buffalo; and 200 TL ($ 29.15) per head additionally to calves born in the "Breeding Regions" determined by the Ministry [750 TL ($ 109.33)] in total in these provinces).

Also, raw buffalo milk breeders are supported via milk premium determined by the Ministry. Besides, registered breeders have been promoted via organizations since 2016 to support breeder organizations.

Before the assessment of the analysis findings, the partial utility provided to breeders and their significances were demonstrated (Table 4).

When the findings are interpreted, the most preferred support component appeared as "animal support". The impact of animal supports in the decision of breeders to reach supports emerged as 32.10%. Breeders first support choice was animal supports accordingly. The secondly preferred component was "investment support" with 21.25%, which was followed by "marketing support" with 16.51%. The fourth preferential choice of breeders was "product support" with 16.18%, and the last valued factor was "investment credit" with 13.96% (Table 4).

Concerning the breeder responses retrieved in the field, the utility-maximizing policy choice appeared as "animal support". Breeders consider animal supports per head as the most beneficial support for their breeding activities (Table 4).

Partial-utility values of all factor layers demonstrate the impact of these layers on an individual's decisions. Accordingly, the highest layer of "animal support" factor maximizing breeder utility appeared as "AS2" with 1.70 partial utility. The "IS2" component of "investment support" was the most effective tool with 1.02 utility values. Existence of "marketing support" led to 0.76 partial utility. The highest partial utility was observed for "PS3" under "product support" factor with 0.20 contributions. In opposition to offers including payment delays, "IC3" option was the most appealing component of "investment credit" factor with 0.13.

Table 4 - Conjoint Analysis findings

Factor	Factor layer	Partial utility	Significance (%)
	AS1	−1.35	
Animal support (AS)	AS2	1.70	32.10
	AS3	−0.36	
	IS1	−0.50	
Investment support (IS)	IS2	1.02	21.25
	IS3	−0.52	
Marketing support (MS)	MS1	0.76	16.51
	MS2	−0.76	
	PS1	−0.14	
Product support (PS)	PS2	−0.06	16.18
	PS3	0.20	
	IC1	−0.01	
Investment credit (IC)	IC2	−0.13	13.96
	IC3	0.13	
Total			100.00
Pearson's R value = 0.983		Significance = <0.01	
Kendall's Tau value = 0.867		Significance = <0.01	

IS1 = 50% grant – two years non-refund; IS2 = 75% grant – two years non-refund; IS3 = 25% grant – five years non-refund; IC1 = without interest – three months delay; IC2 = without interest – no delay; IC3 = low-interest rate – six months; AS1 = 500 TL ($ 72.89) up to 50 heads, 300 TL ($ 43.73) for 51-100 heads, 200 TL ($ 29.15) for 101-250 heads, 100 TL ($ 14.58) for 251 and more heads and three years; AS2 = 800 TL ($ 116.62) up to 50 heads, 600 TL ($ 87.46) for 51-100 heads, 400 TL ($ 58.31) for 101-250 heads, 200 TL ($ 29.15) for 251 and more heads and for once; AS3 = 400 TL ($ 58.31) up to 500 heads, 200 TL ($ 29.15) for 501 and more heads and for once; PS1 = 0.2 TL/L ($ 0.03/L) milk; 1 TL/kg ($ 0.15/kg) meat support; PS2 = 0.2 TL/L ($ 0.03/L) milk; no meat support; PS3 = 0.4 TL/L ($ 0.06/L) milk; 0.5 TL/kg ($ 0.07/kg) meat support; MS1 = existent; MS2 = inexistent.

7

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

The average and total utility values of support combinations directed to individuals with cards were provided (Table 5). While the total utility is the sum of factor layer scores, the combination reached with the highest overall utility value appeared as the utility-maximizing supporting mix for the breeders. On the other hand, the combination with the minimum total utility value provides the minimum utility to breeders.

The combination of policy tools inserted in card 3 appeared as the most appealing option for breeders with 2.15 total utility values. In the scope of this combination, breeders prefer 75% grant and two years non-refundable investment support and investment credit without interest rate and with three months of a payment delay. Also, animal support, including payment for once, was preferred as a component. The financial expectation from animal support tools is "AS2". Without any marketing support, breeders prefer "PS3" in the scope of animal products supports.

On the contrary, the least utility was reached in the 10th card with −2.90 total utility. Accordingly, breeders do not prefer IS3 of investment support and direct payback of investment credit without interest rate imposition. Also, three years payment delay for animals due to scales was not favoured as well under the option of IS1. Low milk support with 0.2 TL ($ 0.03) per litre by high meat support with 1 TL ($ 0.15) per kg was not preferred as well, and the inexistence of marketing support was a part of the least preferred option.

Table 5 - Total utility values of combinations reached with Conjoint Analysis

Card	IS	Partial utility	IC	Partial utility	AS	Partial utility	PS	Partial utility	MS	Partial utility	Total utility
3	IS2	1.02	IC1	−0.01	AS2	1.70	PS3	0.20	MS2	−0.76	2.15
12	IS1	−0.50	IC3	0.13	AS2	1.70	PS1	−0.14	MS1	0.76	1.95
14	IS3	−0.52	IC1	−0.01	AS2	1.70	PS2	−0.06	MS1	0.76	1.87
7	IS2	1.02	IC3	0.13	AS1	−1.35	PS1	−0.14	MS1	0.76	0.42
17	IS1	−0.50	IC1	−0.01	AS1	1.70	PS1	−0.14	MS2	−0.76	0.29
20	IS3	−0.52	IC1	−0.01	AS2	1.70	PS1	−0.14	MS2	−0.76	0.27
1	IS2	1.02	IC2	−0.13	AS1	−1.35	PS2	−0.06	MS1	0.76	0.24
13	IS1	−0.50	IC2	−0.13	AS2	1.70	PS1	−0.14	MS2	−0.76	0.17
16	IS1	−0.50	IC2	−0.13	AS3	−0.36	PS3	0.20	MS1	0.76	−0.03
9	IS2	1.02	IC1	−0.01	AS3	−0.36	PS1	−0.14	MS2	−0.76	−0.25
11	IS3	−0.52	IC1	−0.01	AS3	−0.36	PS1	−0.14	MS1	0.76	−0.27
15	IS1	−0.50	IC1	−0.01	AS1	−1.35	PS3	0.20	MS1	0.76	−0.90
18	IS3	−0.52	IC2	−0.13	AS1	−1.35	PS3	0.20	MS1	0.76	−1.04
2	IS1	−0.50	IC1	−0.01	AS1	−1.35	PS1	−0.14	MS1	0.76	−1.24
8	IS1	−0.50	IC3	0.13	AS3	−0.30	PS2	−0.06	MS2	−0.76	−1.49
4	IS3	−0.52	IC3	0.13	AS1	−1.35	PS3	0.20	MS2	−0.76	−2.30
19	IS1	−0.50	IC3	0.13	AS1	−1.35	PS1	−0.14	MS2	−0.76	−2.62
5	IS1	−0.50	IC1	−0.01	AS1	−1.35	PS2	−0.06	MS2	−0.76	−2.68
6	IS1	−0.50	IC1	−0.01	AS1	−1.35	PS1	−0.14	MS2	−0.76	−2.76
10	IS3	−0.52	IC2	−0.13	AS1	−1.35	PS1	−0.14	MS2	−0.76	−2.90

IS - investment support: IS1 = 50% grant – two years non-refund, IS2 = 75% grant – two years non-refund, IS3 = 25% grant – five years non-refund; IC - investment credit: IC1 = without interest – three months delay, IC2 = without interest – no delay, IC3 = low-interest rate – six months; AS - animal support: AS1 = 500 TL ($ 72.89) up to 50 heads, 300 TL ($ 43.73) for 51-100 heads, 200 TL ($ 29.15) for 101-250 heads, 100 TL ($ 14.58) for 251 and more heads and three years; AS2 = 800 TL ($ 116.62) up to 50 heads, 600 TL ($ 87.46) for 51-100 heads, 400 TL ($ 58.31) for 101-250 heads, 200 TL ($ 29.15) for 251 and more heads and for once; AS3 = 400 TL ($ 58.31) up to 500 heads, 200 TL ($ 29.15) for 501 and more heads and for once; PS - product support: PS1 = 0.2 TL/L ($ 0.03/L) milk; 1 TL/kg ($ 0.15/kg) meat support; PS2 = 0.2 TL/L ($ 0.03/L) milk; no meat support; PS3 = 0.4 TL/L ($ 0.06/L) milk; 0.5 TL/kg ($ 0.07/kg) meat support; MS - marketing support: MS1 = existent; MS2 = inexistent.

8

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

4. Discussion

Direct and indirect supports have a critical impact on buffalo breeding. Micro-level evaluation of breeder expectations and tendencies with regards to supporting tools is vital in the development of supporting policies. In this perspective, supports provided for animal ownership appeared as the most appealing driver for breeders according to our findings. This can be related to the sensitivity of breeders to cash supports. Therefore, cash payments should be considered more carefully by policy developer and implementer organizations.

On the other hand, financing the establishment of productive instalments and infrastructure arrangements for these instalments also appeared as important. Breeders concerned for the study wished to receive as much grant as possible and sometimes lap until the first payback starts. Preference of 75% granted credit with two years of repayment delay, which appeared as the most valuable investment support, is related to this consideration of breeders.

Marketing is an essential aspect of the findings. Marketing of products retrieved in the concerned production or breeding activities seemed not to attract buffalo breeders. This is partly related to the specificity of buffalo breeding, which takes place in different locations and under various conditions in Turkey. However, as the supply of products and byproducts is limited, breeders demonstrated a lack of marketing interest. Production in a limited number of locations and lack of purchasers or dealers lead to a monopolistic market structure. While buffalo products are fragile with short endurance, they also need to be delivered to final operation points at a high pace. However, lack of infrastructure and effective linkages lead to marketing problems. It is well known that the sustainability of specific agricultural production is based on the development and maintenance of sound marketing actions and marketing efforts for buffalo. Accordingly, marketing supports appeared as the third most crucial driver of breeders, while the most appealing policy mix interchanged animal supports with marketing supports. Departing from these characteristics of the market, it appeared as essential that public authorities should intervene in the production and marketing of buffalo and buffalo products.

It was understood that breeders value milk supports rather than meat supports in the scope of product supports. This is related to a high value of buffalo milk in the food market in terms of cream and ice-cream production. However, breeders did not demonstrate enough attention to farm credits or infrastructure investments. This is related to the tendency of existent farms to continue with their scope. Accordingly, focusing on new entrepreneurs or supporting breeders that want to enlarge his/her activities should be considered in depth.

5. Conclusions

The present study was designed to determine the scope of supporting buffalo farms in response to breeders' expectations. According to the findings of the study, it is understood that supporting new entry to the market is essential, and investment supports should be directed to enlargement of activities and new investment options. However, most effective incentives are related to animal or product-based supports. Existing breeders would be willing to continue their activities if animal ownership and buffalo products are supported financially. While the breeders neglected the role of marketing, improvement of marketing channels and tools is also vital for buffalo breeding.

While this study set forward the optimum supporting policy tool expectations, finance of these tools should be considered by policymakers and implementers. Extension services specifically targeting breeding conditions and marketing opportunities seem to be essential as well.

Conflict of Interest

The authors declare no conflict of interest.

9

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

Author Contributions

Acknowledgments

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10

Determination of optimum agricultural policy for buffalo breeding
Taşcioğlu et al.

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