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Analysis of six monthly distribution system for food grains in the public distribution system of Punjab, India: A beneficiary's perspective

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Analysis of six monthly distribution system for food grains in the public distribution system of Punjab, India: A beneficiary's perspective

by

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A thesis submitted to the graduate faculty

in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Major: Industrial and Agricultural Technology

Program of Study Committee:
Shweta Chopra, Major Professor
Thomas J. Brumm
Caroline Krejci

Iowa State University

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DEDICATION

       I would like to dedicate this thesis to millions of my brethren who sleep hungry every day with the hope that this work is a step forward towards ensuring their food security.

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NOMENCLATURE

AAY	Antyodaya Anna Yojana
AHP	Analytical Hierarchy Process
ANP	Analytical Network Process
BPL	Below Poverty Line
BY	Beneficiary
Chisq	Chi-Square
DCP	Decentralized Procurement
FAO	Food and Agricultural Organization
FCI	Food Corporation of India
FPS	Fair Price Shop
IDEF	Integrated Definition for Function modelling
MAUT	Multi Attribute Utility Theory
MCDA	Multi Criteria Decision Analysis
MSP	Minimum Support Price
MUF	Multi-measure Utility Function
NFSA	National Food Security Act
n. d.	No Date
PAIC	Punjab Agro Industrial Corporation
PDS	Public Distribution System
PER	Purchase Entitlement Ratio
PICS	Purdue Improved Cowpea Storage

PH	Priority Household
PSAMB	Punjab State Agricultural Marketing Board
PSWC	Punjab State Warehousing Corporation
SLI	Standard of Living Index
SUF	Single-measure Utility Function
UID	Unique Identification
USD	United States Dollar
VA	Value Analysis
VIF	Variance Inflation factor

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Last but not the least, I cannot express my gratitude enough towards that invisible power for "His" blessings have been infinite.

ABSTRACT

Public distribution system is a food security program in India providing safety net for the below poverty line citizens of the country. Its objective is to feed the most vulnerable population by providing subsidized food grains and other essential commodities on a monthly basis through its integrated network of supply chain. But the system is affected by various inefficiencies and malpractices. To improve the efficacy of the system, the state of Punjab introduced the new atta-daal (wheat pulses) scheme. One of the features of the scheme was to distribute grains to the beneficiaries on a six monthly basis (semi-annually) instead of on a monthly basis. With the change in interval of grain distribution, the policy makers estimated huge financial savings for the state and improved grain quality and quantity for the beneficiaries of the system. But an exploratory research visit suggested some concerns from the beneficiaries such as problems with grain handling and one-time payments. Beneficiaries play a critical role in successful implementation of any new policy directly affecting their livelihoods. Therefore it is essential to understand their perspective. This research is an attempt to analyze and understand the policy through beneficiaries' viewpoint.

The first study investigated the factors affecting the preference of beneficiaries for six monthly distribution system. Historically, their preference for a policy is affected by various socio-economic, demographic and institutional factors. This study was conducted in two stages where-in an exploratory research visit with 40 participants among seven stakeholders helped in defining the research problem and resulted in thematic codes which further helped in designing a survey. Thereafter a survey was conducted among

300 beneficiaries across eight rural and six urban locations in district of Ludhiana in Punjab. Analysis of the data using logistical regression modelling yielded several facilitating, impeding and demographic factors which affect beneficiaries' preference to successfully adopt the new policy. These factors included "monthly hassle", "perception of leakages in system", "storage challenges", "interval of grain distribution", "one-time down payment", "trade of bulk grains by family", "exploitation by middle-men", "communication of arrival of grains", "gender", "area" (rural/urban) and "nature of employment". A deeper understanding of these factors helped authors make policy suggestions to the policy makers.

The second study uses multi-attribute utility theory for a formal decision analysis of the six monthly distribution system and its various identified alternatives from beneficiaries' perspective. Authors use the data collected during exploratory research visits and survey conducted with 300 beneficiaries to identify the overall objective of introducing the policy change. This data is further used to identify various alternatives to six monthly distribution system and the best alternative for beneficiaries. Authors compare all the alternatives to understand their relative strengths and weaknesses and further make suggestions to improve the status quo. Five feasible "alternatives" for six monthly interval of grain distribution (status quo) were quarterly distribution, annual distribution, the old one monthly system, a one monthly system with new regulations and an improved six monthly distribution system. The improved six monthly system was identified as the best solution among given alternatives. A sensitivity analysis established the robustness of the solution.

CHAPTER 1. GENERAL INTRODUCTION

Introduction

According to Food and Agricultural Organization (FAO), food insecurity is one of the biggest challenges faced by humanity today. Reports from the organization suggest that approximately 795 million people around the world are suffering from acute hunger (FAO, 2015). This accounts for an alarming 11% of the total world population out of which 98% are in developing countries in Africa, Asia and Latin America (IFPRI, 2016; WHES, 2016). The region of South Asia which includes India, Pakistan, Nepal, Bangladesh, Bhutan, Sri Lanka and Maldives inhabits 35% of the total undernourished of the world.

To deal with the problem government of India started one of the largest public programs of distributing subsidized food grains and other commodities to its pre-identified below poverty line (BPL) citizens called the Public Distribution System (PDS) (Ministry of Consumer Affairs, Food & Public Distribution, 2016). The formal inception of this system can be traced back to India's independence in 1947 with several improvements over the years. According to Bajaj (2012) the government currently spends USD 13.6 billion every year on the program, equivalent to 1% of its gross domestic product (GDP), yet 21% of the total population suffers from chronic hunger. Despite of 1.5 times increase in the food production volumes, little has improved over past two decades.

According to World Bank (as cited in Bajaj, 2012), inefficiencies of the distribution network, supported by corrupt practices and inadequate storage facilities,

result in a loss of 58.6% of the total grain lifted by the state governments from federal

warehouses. The inefficiencies are rampant across the full supply chain from

procurement, warehouse management to fair price shops (FPS). From the grains that

reach the intended population many beneficiaries complain about quality, quantity and

price distortions along with inclusion and exclusion errors (Bajaj, 2012; Balani, 2013).

The responsibilities of PDS are shared among the state and the federal

governments with states entrusted with identification of beneficiaries and distributing the

procured grains. Many states in India have tried to address these concerns through

different technological interventions and supply chain strategies such as digitization of

transactions in Chhattisgarh and Madhya Pradesh, and universal PDS in Tamil Nadu

(Balani, 2013). The state of Punjab formally introduced new atta-daal (wheat pulses)

scheme in 2014 to improve the efficiency of the existing system (Dept. of Food Civil

Supplies & Consumer Affairs, 2014). This scheme was introduced by the then

government of Akali dal – BJP and was based on the guidelines and directives of the

National Food Security Act (NFSA) 2013. The state government observed criticism from

several stakeholders for the scheme. Many believed this to be a populist measure due to

upcoming state elections and others felt it to be a financial burden (Sharma, 2016). But

the experts from the state government believed it to be beneficial not only for the state

but for the beneficiaries as well (Puri, 2014). One of the features of the scheme was

distribution of food grains to beneficiaries on a six monthly basis (semi-annually) instead

of on a monthly basis. The policy makers estimated an annual state saving of USD 25.4

million with the implementation of this proposed change but an exploratory research

investigation reflected several concerns with the beneficiaries such as difficulty in grain handling, decreased female participation and increased one-time payment for grains.

According to literature, for effective implementation of such policy initiatives it is important to recognize beneficiaries' perspective as they are the most important stakeholders of the supply chain (Jain & Polman, 2003). This study is an independent attempt to understand beneficiaries' perception regarding change in such policies.

Objectives

The primary objectives of the research were:

- To identify and understand the impeding, facilitating and demographic factors affecting beneficiaries' preference for six monthly distribution of food grains in the public distribution system of Punjab, India

- To identify and understand several possible alternatives to "six monthly" interval of grain distribution and find the best solution among these alternatives for the public distribution system of Punjab, India

Thesis Organization

This thesis follows format for journals where these manuscript have already been or will be submitted in near future. Each chapter in this thesis is self-contained. Chapter 1 is a general introduction of the topic highlighting the overall research objectives with references (this chapter). Chapter 2 and 3 include an abstract, introduction along with literature review, methodology with figures and tables, results, discussion with limitations and future work, conclusions and references followed by chapter 4 which includes a general summary and conclusions for the thesis.

Chapter 2 titled "Factors affecting beneficiaries' preference for six-monthly distribution of food grains in Punjab, India: A step towards decentralized policy making in public distribution system" is a research paper modified from the manuscript already submitted to the "International Journal on Food System Dynamics" and is currently under review. Chapter 3 titled "A multi-objective decision analysis of six monthly distribution system for food grains in public distribution system of Punjab, India" is a research paper modified from the manuscript under internal review to be submitted to the journal "Decision Analysis".

References

Bajaj, V. (2012, June 7). As grain piles up, India's poor still go hungry. *The New York Times.* Retrieved from http://www.nytimes.com/2012/06/08/business/global/a-failed-food-system-in-india-prompts-an-intense-review.html?_r=1&smid=FB-nytimes&WT.mc_id=BU-E-FB-SM-LIN-AGP-060812-NYT-NA&WT.mc_ev=click

Balani, S. (2013). Functioning of the Public Distribution System, an analytical report. *PRS Legislative Research*. Retrieved from http://www.prsindia.org/administrator/uploads/general/1388728622~~TPDS%20Thematic%20Note.pdf

Dept. of food civil supplies & consumer affairs, Government of Punjab. (2014). *New Atta Dal Scheme*. Retrieved from http://foodsuppb.nic.in/newattadal.html

FAO. (2015).*The state of food insecurity in the world*. Retrieved from http://www.fao.org/3/a-i4646e.pdf

International Food Policy Research Institute. (2016). *2016 Global hunger index*. Retrieved from http://www.ifpri.org/publication/2016-global-hunger-index-getting-zero-hunger

Jain, S. P., & Polman, W. (2003). A handbook for trainers on participatory local development -The panchayati raj model in India. *Food and Agriculture Organization*. Retrieved from ftp://ftp.fao.org/docrep/fao/006/ad346e/ad346e00.pdf

Ministry of Consumer Affairs, Food & Public Distribution, Government of India. (2016). *Targeted Public Distribution System.* Retrieved from http://dfpd.nic.in/public-distribution.htm

Puri, A. (2014, May 2). A grain of sense – how Punjab is making the best use of the flawed public distribution system. *The Indian Express*. Retrieved from http://indianexpress.com/article/opinion/columns/a-grain-of-sense/

Sharma, P. (2016, April 19). Punjab dug into central funds to bankroll atta-dal scheme. *Hindustan Times*. Retrieved from http://www.hindustantimes.com/punjab/punjab-dug-into-central-funds-to-bankroll-atta-dal-scheme/story-IumLMWW2hQcLb2mfxyEBwJ.html

World Hunger Education Service. (2016). 2016 *World hunger and poverty facts and statistics*. Retrieved from http://www.worldhunger.org/2015-world-hunger-and-poverty-facts-and-statistics/

CHAPTER 2. FACTORS AFFECTING BENEFICIARIES' PREFERENCE FOR SIX MONTHLY DISTRIBUTION OF FOOD GRAINS IN PUNJAB, INDIA: A STEP TOWARDS DECENTRALIZED POLICY MAKING IN PUBLIC DISTRIBUTION SYSTEM

A paper submitted to the *International Journal on Food System Dynamics*

Abhay K. Grover[1], Shweta Chopra[1]

Abstract

Improving upon the existing scheme of distributing subsidized grains to its below poverty line (BPL) citizens on a monthly basis, Punjab government in 2014 launched "new atta-daal (wheat-pulses) scheme" under Public Distribution System (PDS). Along with other provisions in new scheme, the state decided to distribute grains on a six-monthly basis (semi-annually) instead of every month. The state claimed various monetary benefits whereas beneficiaries expressed concerns with the changes. For effective implementation of such policy initiatives it is important to recognize beneficiaries' perspective as they are the most important stakeholders. Historically, their preference for a policy is affected by various socio-economic, demographic and institutional factors. Thus, the purpose of this research was to identify and understand factors affecting beneficiaries' preference for successful adoption of six-monthly distribution system. This study used data collected from a survey of over 300 beneficiary households across 14 different villages (rural) and localities (urban) of Ludhiana district in Punjab. Data were analyzed via logistic regression modelling. Factors affecting

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beneficiaries' preference included "monthly hassle", "perception of leakages in system", "storage challenges", "interval of grain distribution", "one-time down payment", "trade of bulk grains by family", "exploitation by middle-men", "communication of arrival of grains", "gender", "area" (rural/urban) and "nature of employment". Beneficiaries perceive that with the six-monthly system "leakages" and "monthly hassles" have decreased but they find six months to be a "long interval" and "one-time payment" a challenge which the state needs to address. However, there was insufficient evidence to conclude that beneficiaries preferred either (one or six-monthly) system more. Furthermore, the study suggests that beneficiaries are rational consumers looking to maximize utility therefore consumer trust and satisfaction are recommended as important performance indicators for such distribution policies.

Introduction

There are 795 million food insecure people worldwide and 98% of them are in developing countries like India (FAO, 2015). To support its below poverty line (BPL) citizens, the federal government along with different state governments in India, operate a Public Distribution System (PDS) (Kishore & Chakrabarti, 2015). With PDS, an estimated 160 million beneficiary households purchase their subsidized monthly entitlement of food grains and other essential commodities through a network of 500,000 Fair Price Shops (FPS) (Ministry of Consumer Affairs, Food & Public Distribution, 2011). But the efficacy of PDS as an enabler of food security has been hampered by various malpractices such as leakages, black-marketing, and adulteration (Balani, 2013; Rajan et al., 2016). As a result many states in India have tried to address these issues through different technological interventions and supply chain strategies such as

digitization of transactions in Chhattisgarh and Madhya Pradesh, and universal PDS in Tamil Nadu (Balani, 2013).

The state of Punjab, which contributes 43% of total wheat to central pool (Economic & statistical organization, 2013), has been at forefront of PDS transformations. Based upon provisions of National Food Security Act (NFSA) 2013, the Punjab government modified its existing PDS structure by launching new atta-daal (wheat-pulses) scheme in 2014 (Dept. of Food Civil Supplies & Consumer Affairs, 2014). Some of the prominent features of the scheme include that: (1) the eldest woman will be head of family; (2) eligible beneficiaries will be identified on basis of unique identification (UID) number; (3) wheat will be distributed at USD 0.03 per kg; (4) every household member will get five kg wheat per month without any upper cap; (5) an unsatisfied beneficiary can go to a consumer court; and (6) the entitlement of wheat will be given to beneficiaries semi-annually or on a six-monthly basis. Specifically, requirements of six-monthly distribution system overhauled the existing method of storage and distribution of wheat grains[1]. Particular requirements of six-monthly distribution system include that (6a) distribution of grains will be conducted under direct supervision of food, civil supplies department, and (6b) wheat will be distributed in 30 kg sealed bags equivalent to six months entitlement of a beneficiary (Dept. of Food Civil Supplies & Consumer Affairs, 2014).

As illustrated in Fig. 2.1, prior to six-monthly distribution system farmers used to bring their produce to state established markets where commission agents facilitated the sale of wheat grains to procurement agencies. The state agencies, on behalf of central

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[1] Although black grams (pulses) are an integral part of new atta-daal (wheat-pulses) scheme, there is no explicit mention of same in the provisions, therefore authors focus on wheat supply chain only

government, procured wheat from around 1,750 markets across Punjab and stored it accordingly (Economic & statistical organization, 2013). The central government released the state entitlement of wheat grains for monthly requirement through Food Corporation of India (FCI). These stocks were transported to FPS where beneficiaries would buy wheat on a monthly basis. With six-monthly distribution system, instead of storing wheat in state agency warehouses for long term, it is now packed in 30 kg bags and delivered to end users immediately after procurement (Puri, 2014) under direct supervision of food inspectors twice a year.
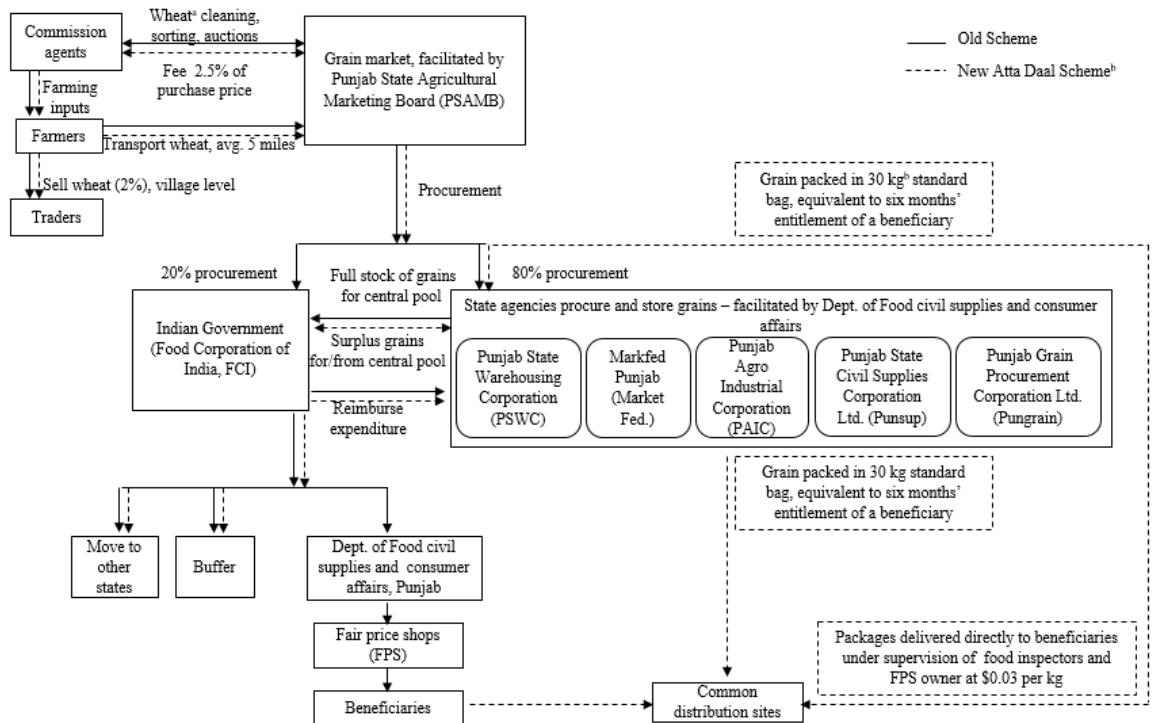
[a] The state of Punjab follows decentralized procurement (DCP) for wheat under NFSA obligations (Food Corporation of India, 2016)
[b] This flow-chart is based on the data collected during authors' field visit in Aug 2015; since then this policy has undergone some progressive changes based on stakeholders' feedback - the role of some stakeholders and rates/quantities are subject to change

Figure 2.1. Schematic flow of wheat grains through old and new atta-daal (wheat-pulses) scheme

Despite of several implementation challenges with six-monthly distributions system, the state government and policy makers claim numerous benefits for administration and beneficiaries alike (refer Table 2.1). In-spite of these claimed benefits, exploratory field visits by authors suggested several concerns with beneficiaries.

Table 2.1. Benefits of six-monthly distribution system as claimed by policy makers and literature

Benefits	Definition	Source of claim
Quantity (↑)	Distribution of accurate amount of grains, decreasing weighing malpractices with sealed bags containing pre-packaged grains as per entitlement	State government (Tribune news service, 2015)
Quality (↑)	Distribution of fresh grains (not rotten), of superior standard and sealed bags to ensure no adulteration	State government (Tribune news service, 2015)
Hassle (↓)	Distribution of grains once in six months against once in a month, saving consumers time, energy from engaging with PDS frequently	Kumar (2015)
Consumer empowerment (↑)	Beneficiary exercises complete control and independence over food grains, improving utilization and reduced dependence on FPS	State government (Tribune news service, 2015)
Delivery mechanism efficiency (↑)	Distribution in front of community under direct supervision of food inspectors to intended beneficiary, leading to continuous evaluation and monitoring	Dept. of food civil supplies & consumer affairs, Govt. of Punjab (2014)
Leakages (↓)	Decrease in siphoning of food grains during transportation to ration shops into open markets	Gaikwad (2010), Puri (2014)
PDS performance (↑)	Increased purchase-entitlement ratio (PER) i.e. proportion of grains that the household is entitled to against actual purchased - A higher PER suggests that PDS delivers better	Dept. of food civil supplies & consumer affairs, Govt. of Punjab (2014)
State expenditure (↓)	Decrease in transportation, storage and preservation cost for state government resulting in savings[a]	Puri (2014)
Logistical complexity(↓)	Simplified logistical movement of grains from markets to beneficiaries, making it more manageable	Puri (2014)
Grain wastage (↓)	Decrease in storage time at government warehouses and less handling of grains resulting in reduced wastage	Puri (2014)

(↑) – Increased, (↓) – decreased
[a] According to an estimate state government could save USD 25.4 million p.a. with successful implementation of six-monthly system (Puri, 2014)

Understanding the importance of beneficiaries' role towards effective policy implementation, Jain and Polman (2003) formally defined decentralization as a mechanism of empowering marginalized beneficiaries by involving them in planning, and implementation of schemes which affect them directly. Their participation and feedback helps in addressing concerns affecting their daily lives which in turn help them appreciate the macro level constraints in policy making. Lack of involvement of these critical stakeholders has often resulted in marginalization of several sections of rural poor resulting in ineffective implementation of developmental programs (Jain & Polman, 2003).

Furthermore, it has been observed in the literature that policy adoption and preference of beneficiaries are affected by various environmental, socio-economic, and demographics factors (Kabir et al., 2013). Khera (2014) studied the impact of cash transfer instead of in-kind subsidies on beneficiaries for PDS in India. She classified factors affecting beneficiaries' preference into two categories i.e. direct factors as (1) insecurities arising from lack of trust in the existing system; (2) concerns with efficiency of the proposed system; (3) lack of familiarity with proposed interventions; (4) concerns with food security; (5) misuse of resources; and (6) ease of interaction with the system and indirect factors as (1) education; (2) age; (3) gender; (4) caste; (5) employment; and (6) standard of living.

Tey et al. (2014) highlighted various systemic factors affecting the preference of beneficiaries for such policies. They proposed an integrative framework based on theory of interpersonal behavior suggesting that expectations, insecurities and existing social norms affect the intentions and perceived preference behavior. Additionally they

proposed that perceived attributes such as relative advantages, disadvantages, and complexity also affects the beneficiaries' preference. Namara et al. (2007) highlighted the role of institutional factors such as trainings, participation in institutional arrangements, and social organizations in influencing the preferences. They further grouped several factors into various categories as demographic structure (family size, head of family, age of family members, gender distribution), human capital variables (age, education, employment), existing resources, and other socio economic variables (caste, social status, poverty index).

Since beneficiaries' inputs are essential for policy formulation and various factors affect their preferences, the purpose of this research is to identify and understand those factors. Further, these identified factors can help policy makers and researchers to address beneficiaries' concerns for effective implementation and provide critical indicators for evaluation of the scheme. Moreover, Punjab is one of the first states to implement six-monthly distribution system (Puri, 2014) so a better understanding of beneficiaries' perspective could help extend the learnings to other states. Also, there is limited or no research on policy preference of beneficiaries for an extended interval of grain distribution. Accordingly, this research will fill the gap in the literature to understand beneficiaries' preference by developing logistic regression models. This research also contributes to a broader debate of decentralization in developmental policies and the role of beneficiaries at large.

Methodology

This research was conducted in two stages (1) an exploratory research; and (2) a survey (see Fig. 2.2). Exploratory research gathered preliminary information, define research problem, formulate research design, and finalize data collection method (Stebbins, 2001). Field visits, guided conversations, semi-structured interviews, and focus group discussions were conducted with several stakeholders in their natural settings. In the second stage authors conducted 300 beneficiary household surveys in 14 different villages and localities in district of Ludhiana across several socio-economic backgrounds using snowball sampling. Survey provided primary data for further analysis. Three different logistic regression models were developed with facilitating, impeding, and demographic variables. These helped identify factors affecting beneficiaries' preference for six-monthly distribution system. Following subsections will describe exploratory research, survey design, participant profiles and logistic regression models in detail.
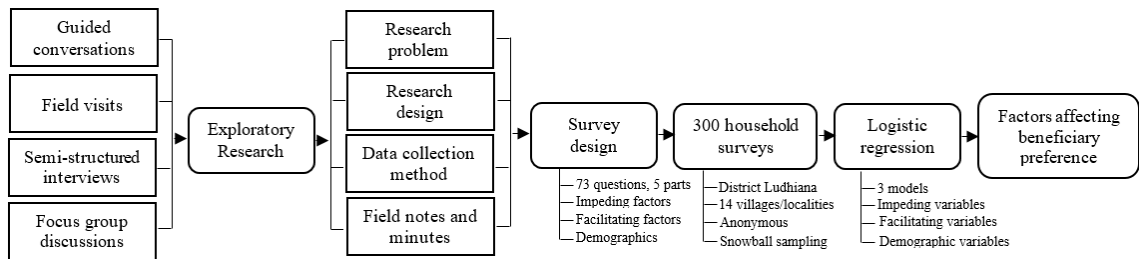
Figure 2.2. Methodological flow and timeline of the research study

Exploratory research

With preliminary study of existing literature, authors visited Punjab – India from July to August, 2015. Authors spent 40 days in field conducting exploratory research in three districts of Punjab i.e. Amritsar, Jalandhar, and Ludhiana. These districts were selected based on maximum number of FPS and maximum volume of beneficiaries

served (Economic & statistical organization, 2013). The first part of the exploratory study was archival research wherein authors collected information from archival records at the state library to supplement field notes for defining research problem. The next part of the study was to identify and contact different stakeholders to gain field access. Once stakeholders were identified, they were contacted via email, telephone and personal visits. Authors used naturalistic inquiry to observe their life experiences and interact with different stakeholders in their natural setting (Chopra, 2014). Focus group discussions were often used to collect a range of opinion and ideas. Semi-structured interviews were conducted where-in participants were asked predetermined open-ended questions to stimulate discussions (Grover et al, 2016; Longhurst, 2003). Authors used field notes, minutes of meeting, audio and video recordings to collect field data. 55 hours of observation and over 40 interviews ranging from one to four hours resulted in 98 single-spaced pages of field data and 10 hours of audio and video footage (see Table 2.2). These data were transcribed and organized in Microsoft Word® document. Authors then coded the data and emergent codes were grouped into common themes based on their underlying similarity as impeding, facilitating and demographic factors (Grover et al., 2016). These themes were later used to design a survey and identify variables for logistic regression models. The exploratory part of the study helped authors to understand the PDS supply chain, identify different stakeholders and define research problem (see Fig. 2.2) (Stebbins, 2001). Table 2.2 represents different stakeholders, type of data collected from each stakeholder, and number of members interviewed along with time duration.

Table 2.2. Different stakeholders, type of data, duration and technique used

Stakeholders	No. of participants	Type of data	Duration of data collection (hours)	Meeting place	Techniques used
Beneficiary	11	Field notes, minutes of meeting	15	Villages, FPS (Amritsar, Ludhiana)	Focus group discussion, semi-structured interview
Fair price shop (FPS)	5	Field notes, minutes of meeting, video[a], photograph[a]	9	FPS (Ludhiana, Jalandhar)	Semi-structured interview, participant observation
Dept. of Food civil supplies & consumer affair, Punjab	3	Field notes, minutes of meeting	8	Office (Chandigarh)	Semi-structured interview, guided conversation
Dept. of Agriculture, Punjab	2	Field notes, minutes of meeting	3	Office (Chandigarh)	Semi-structured interview, guided conversation
Food corporation of India (FCI)	10	Field notes, minutes of meeting	9	FCI office (Amritsar, Ludhiana)	Focus group discussion, semi structured interview
Policy scientists	3	Field notes, minutes of meeting	7	Office (Ludhiana)	Semi-structured interview
Ground staff (technical, non-technical)	6	Field notes, minutes of meeting, video[a]	4	Office (Ludhiana, Chandigarh)	Focus group discussion, semi structured interview

[a] Participant consent was taken before taking photographs, video or audio recordings - the recordings were focused at the processes rather than individuals

Survey

Design

   Themes identified from exploratory research data were used to design the survey. The survey questions comprehensively illustrated various factors that might potentially affect beneficiaries' perception towards six-monthly system. Survey guidelines were used

from data collection instrument developed and validated by Khera (2014). The survey[1]

was divided into following parts: (1) household demographics; (2) PDS attributes; (3)

six-monthly system attributes; (4) beneficiary's perception regarding advantages; and (5)

beneficiary's perception regarding disadvantages of the new system. The survey had 73

close-ended questions. The perception based questions were designed on a seven point

Likert scale[2] to appropriately collect variations in participant responses (Neuendorf,

2002). The survey questionnaire was validated using face validity where-in the feedback

from field experts was used to improve the existing design (Chopra, 2014; Neuendorf,

2002). The survey was also pretested among 15 beneficiaries before dissemination.

Survey administration

Authors again visited Punjab – India from July to August, 2016 to conduct the

survey among eligible beneficiary households as discussed in "participants" section.

Based on inputs from exploratory research, Ludhiana was selected for survey

dissemination as it is the largest district of Punjab with a population of 1.7 million and

has highest number of FPS with over 400,000 registered beneficiary households

(Economic & statistical organization, 2013). Authors were well versed with the local

language which made it convenient to identify and gain access of eligible beneficiary

households. They disseminated over 300 surveys across 14 villages and localities in the

district, spanning over 29 days. Every survey took approximately 45~50 minutes and

contained a cover letter and a consent document explaining details of the research study

and participant rights respectively. Participant identity was kept anonymous and every

survey was given a unique code identifier.

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[1] Survey can be obtained by contacting the authors
[2] Seven point Likert scale ranges from -3 to +3 where -3 refers to strongly disagree, +3 refers to strongly agree and 0 refers to a neutral response

<u>Survey responses and content analysis</u>

A spreadsheet was designed using Microsoft Excel® for manual data entry. Once the data were entered, process of data cleaning was carried out wherein inaccurate and corrupt entries were modified or deleted (Wu, 2013). Data were mostly entered in categorical or continuous format. Response to some of the negatively worded questions was reverse coded so that values indicate same type of response on every item (Weems & Onwuegbuzie, 2001). Missing values were not imputed as much of data were categorical in nature. Authors combined responses into nominal groups and summed the Likert scale as agree (1) or disagree (0) to reduce data (Berning et al., 2010). Data were analyzed using JMP ® pro 12.0.1 by SAS. Since output responses were binomial, authors used logistic regression to develop models (Tey et al., 2014).

Participants

Purposive sampling was used to identify key participants and thereafter used participant referral (snow ball sampling method) to recruit other beneficiary households. This method is also known as respondent driven sampling and is used to identify beneficiaries with specific attributes (Abdul-Quader et al., 2006; Creswell, 2009). Beneficiary households who registered with PDS recently and had no prior experience with a monthly distribution system were not considered. Table 2.3 gives the characteristics of survey respondents. In all, 300 beneficiary households were surveyed across eight rural villages and six urban localities in the district of Ludhiana. Since identification of eligible households is a state prerogative, the state of Punjab designated the following as eligible under new atta-daal (wheat-pulses) scheme: (1) households

Table 2.3. Characteristics of the survey respondents and their households (n = 300)

Characteristic	Number	Percent (%)
Age (years)		
21 – 30	42	14.00
31 – 40	114	38.00
41 – 50	86	28.67
51 – 60	33	11.00
≥ 61	25	8.34
Gender		
Male	102	34.00
Female	198	66.00
Education		
No education	79	26.33
$\leq 5^{th}$ Grade	116	38.67
Secondary (10th Grade)	85	28.33
Higher secondary (12th Grade)	18	6.00
College	2	0.67
Employment		
Casual Labor	143	47.67
Self-employed	61	20.34
Housewife	80	26.67
Area		
Rural	201	67.00
Urban	99	33.00
Vehicle		
None	8	2.67
Cycle	244	81.34
Motor cycle/scooter	206	68.67
House type		
Semi-pukka (makeshift)	179	59.67
Pukka (permanent)	116	38.67
Size of agricultural land		
None	245	81.67
< 2.5 acres	32	10.67
2.5 to 5 acres	23	7.67
Head of family		
Gender		
Male	253	84.37
Female	46	15.34
Avg. age (years)	53.13	
Avg. family size	4.86	
Standard of living index (SLI)[a]		
Low (< 2)	152	50.67
Medium (2 to 6)	101	33.67
High (> 6 above)	47	15.67
Avg. distance from PDS outlet (miles)	0.89	

[a] 'SLI' has been created by weighting ownership of assets. See Khera (2011) for more details

already identified under Antyodaya Anna Yojna (AAY)[1] scheme; (2) households already

identified as BPL by latest census reports (BPL cards)[2] or with old state-PDS scheme

(blue cards); (3) households with disabled head of the family; (4) landless daily paid

workers, or single widowed head of the family; (5) farmer households having less than

2.5 acres of land; and (6) households with gross annual income less than USD 896 (Dept.

of food civil supplies & consumer affairs, 2014a).

Multiple logistic regression

Three different logistic regression models were developed to study facilitating,

impeding and demographic factors influencing the preference of beneficiary households

towards six-monthly distribution system. In this study participants either preferred or not

preferred six-monthly distribution system. So given a binary choice and computational

convenience logistic regression was an appropriate statistical tool (Greene, 2008). This

has been widely used in literature to model binary response variables against categorical,

or nominal explanatory variables (Berning, 2010; Khera, 2014). It uses a logit function

which helps measure the log odds of success of an event. The degree and directional

outcomes from the model help understand how different explanatory variables affect

probability of occurrence of events (Long & Freese 2006; Tiwari et al., 2008).

Empirical modelling

Author's followed a traditional approach of constructing the most parsimonious

model as this helps in stabilizing model numerically. Some researchers suggest including

all clinically relevant variables in the model regardless of their statistical significance as

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[1] AAY scheme is sponsored by the Government of India to support the poorest of the poor and was started in Dec' 2000 (Ministry of Consumer Affairs, Food & Public Distribution, 2016)

[2] According to the directives of NFSA 2013 the state of Punjab categorized all beneficiary households as Priority Household (PH) except AAY households

this provides control of confounding. But with this approach the model may become over

fit and generate larger estimates for coefficients and standard errors (Hosmer &

Lemeshow, 2000). The model in terms of probability is specified as:

$$p_i = \frac{\exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki})}{1 + \exp(\beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki})} \tag{1}$$

Where,

p_i is probability of an event occurring for an observed set of variables x_{ki}
β_0 is intercept term defined as the value of log odds of success when all x_k are 0
$\beta_1, \beta_2, \dots, \beta_k$ are estimated parameters corresponding to each explanatory variable
$x_1, x_2, \dots, x_k$ are explanatory variables

Given that p_i is probability of beneficiary preferring six-monthly distribution

system, then $1 - p_i$ is the probability of not preferring six-monthly system. The odds for

preference are $p_i/(1 - p_i)$ and its log odds i.e. logit is $y = \ln[p_i/(1 - p_i)]$. This

transforms the nonlinear equation Eq. 1 into a linear equation Eq. 2. The dependent

variable y was modeled as: y = preference for six-monthly system. So p(y) = {1 if the

households preferred six-monthly system, and 0 otherwise}. So the logistic prediction

model (Agresti, 2007; Kabir et al., 2013) is specified as:

$$\ln\left(\frac{p_i}{1-p_i}\right) = \beta_0 + \beta_1 x_{1i} + \beta_2 x_{2i} + \dots + \beta_k x_{ki} \tag{2}$$

For model with a two group categorical explanatory variable

$$x_{ki} = \begin{cases} 1 \ if \ the \ ith \ obs. is \ in \ group \ 1 \\ \quad 0 \ otherwise \end{cases}$$

Firstly, data were checked for multi-collinearity[1] as this might suggest over-

prediction. The variance inflation factor (VIF) was less than five for the study. Variables

were categorized as nominal or categorical depending upon the data. Data were also

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[1] Multicollinearity for categorical variables can be verified using phi-coefficient or tetrachoric correlation (Ekstrom, n. d.). Authors verified multicollinearity for continuous variables only

checked for outliers using box-plots and residual statistics. Further, a contingency table and Wald statistic was used to test individual explanatory variables to test for significance. Any variable whose uni-variable test had a p-value less than 0.25 was retained. A stepwise fit method was used for variable selection by applying mixed direction regression control. Finally, the model was checked for interactions and a preliminary model was generated (Hosmer & Lemeshow, 2000).

The specified model was tested for different parameters (Hosmer & Lemeshow, 2000). Firstly, the model was tested for whole-model fit by comparing to the reduced model i.e. one that omits all explanatory variables except the intercept constant. Secondly, R-square (U) also known as McFadden's pseudo R^2 was checked to verify the power of model in predicting response variable. The R-square value ranges from zero for no improvement to one for a perfect fit. Lastly, a lack of fit test was used to estimate whether more complex terms need to be added to the model. A significant lack of fit test suggests the need for higher order terms or interaction terms.

<u>Variable selection</u>

The state government suggested several benefits[1] of six-monthly distribution system for beneficiaries as listed in Table 2.1. Beneficiaries reported several concerns with the system as identified by exploratory research data (see Table 2.4). Furthermore, content analysis of field notes also suggested several demographic factors that affect beneficiaries' preferences (see Table 2.3). Therefore based on identified themes in exploratory research section authors estimated three different logistic regression models

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[1] Table 2.1 contains benefits for administration and beneficiaries, but for model development only variables that are direct benefit to beneficiaries were considered

as (1) facilitating variables (as listed in Table 2.1), (2) impeding variable as listed in Table 2.4), and (3) demographic factors (as listed in Table 2.3).

Table 2.4. Concerns of beneficiaries with six-monthly distribution system as observed by authors during exploratory research

Variables[a]	Concerns	Anecdotal evidence
Storage	Beneficiaries must store 150 kg[b] of grains for six months instead of 25 kg for a month. Don't have proper storage bins and store rooms	"…*we don't have a pukka* [permanent] *house, where will we store* [bulk] *grains…*" – (BY – 1) [c]
Transportation	Beneficiaries must transport 150 kg[b] of grains from PDS outlet to respective storage places. Don't have required vehicles	"…*have a cycle. Generally have to hire a cart or rickshaw. With monthly distribution it was easy…*" – (BY – 2)
Preservation	Beneficiaries must preserve bulk grains from insects, pests, fungus etc.	"…*I generally use neem* [Indian lilac] *leaves instead; cannot spend on expensive remedies* [commercial insecticides]…" – (BY – 3)
Cost	Storage, transportation, preservation require additional logistical resources. Cost of grain management has increased	"…*Government. has transferred storage cost to us instead…*" – (BY – 1)
Timely distribution	Distribution of grains is not timely and is irregular. Beneficiaries have to wait for more than six months to receive their entitlement	"...*have not received grains from past 9 months...*" – (BY – 4)
Long interval	Six months is a long interval of time	e.g. Distribution should be quarterly instead[d]
One-time payment	Beneficiaries have to pay for six months of grains (USD 4.5)[b] at once rather than monthly payments of USD 0.75	"*I am daily wage laborer; it's difficult at times but manageable…*" – (BY – 1)
Grains traded	Subsidized bulk grains have high market price and can be traded for some unwanted commodity by any family member leaving others vulnerable	e.g. Males could trade grains for money to buy alcohol
Exploitation by middlemen	With bulk distribution, various middle men can exploit beneficiaries for money or in-kind benefits	"…*FPS owner charges for wheat bag sometimes…*" – (BY – 4) "… [with no space] *I store my grains with private flour mill personnel, he charges me for that…*" – (BY – 1)

Table 2.4. Continued

Communication of stock arrival	Lack of communication regarding arrival of grains (1) Time between communication and arrival of grains is less to make arrangement for resources (2) If one misses the announcement it is tedious to get grains	e.g. announcement should be made a week in advance through mobile messages or pamphlets[d]
PDS outlet distance	PDS outlet or common site of distribution is further away from beneficiary's house than the FPS	
Inaccessible for females	Since this involves (1) transporting and lifting of 150 kg grains, (2) distribution happens at common sites and (3) higher sum of money is involved – it might become difficult for females to participate	

[a] Variables as identified using exploratory research data by thematic coding
[b] Calculations based on average family size of five members
[c] BY - Beneficiary (where 1, 2, 3… are the codes for different beneficiaries)
[d] Author's observations from exploratory research or literature review

Results

As discussed three sets of regression were created. The whole model test was statistically significant at $p = 0.05$ for all three models. Mc-Fadden's pseudo R square values were between 0.2 and 0.4 indicating good fit and predictive ability for all models (Clark & Hosking, 1986; Domencich & McFadden, 1975). Lack of fit test was insignificant for facilitating and impeding models but was significant for model containing demographic variables indicating need for interaction terms. Two way interaction terms were added to the model for goodness of fit (Hosmer & Lemeshow, 2000). Overall results provided adequate support to reliability, predictive power and goodness of fit for all three models.

After a step-wise selection procedure was applied on all facilitating variables listed in Table 2.1, only important variables were retained on the basis of significance. Refer Table 2.5 for list of variables included in the model. Out of these only "hassle" and "leakages" were significant at one percent. The significant explanatory variable "hassle"

Table 2.5. Facilitating factors regressed on the preference of beneficiary for six-monthly distribution system (n = 160)

Variables	Estimate	Exponents	Standard error	Chi-square	Prob>chisq
Quantity	0.07	1.08	0.29	0.07	0.80
Quality	0.24	1.27	0.28	0.72	0.40
Hassle	0.81	2.24	0.30	7.31	0.007***
Independence to manage grains[a]	0.59	1.81	0.43	1.93	0.17
Delivery mechanism	0.09	1.09	0.22	0.16	0.70
Leakages	1.10	2.99	0.28	15.19	<0.0001***
PDS performance	0.08	1.08	0.27	0.77	0.77
FPS dependence[a]	-0.30	0.78	0.55	0.21	0.65
Intercept	-0.13	0.88	0.41		0.75
McFadden's pseudo R^2	0.22				

Whole model test (-log likelihood difference 23.00, chi-square 46.00, prob>chisq <0.0001), lack of fit (-log likelihood difference 23.92, chi-square 47.83, prob>chisq 0.09), ***indicates statistical significance at 1%

[a] As per definition consumer empowerment (Table 2.1) was further categorized into two variables i.e. (1) independence to manage grains, and (2) FPS dependence

"Preference for six-monthly system" = 1 if respondents prefer six-monthly distribution system over monthly system, = 0 otherwise; "Hassle" = 1 if six-monthly system was less botheration as compared to regular monthly visits, = 0 otherwise; "Leakages" = 1 if respondents felt that leakages have decreased with six-monthly system as compared with monthly system, = 0 otherwise;

has a coefficient estimate of 0.81 and exponent value of 2.24. This suggests that all other explanatory variables held constant, odds of success of preferring six-monthly system when the beneficiaries perceive that hassle has decreased with system is 2.24 times or 124% the odds of preferring six-monthly system when they perceive that hassle has not decreased. Other variable i.e. "leakages" can be interpreted in the same way. These

results suggest that "hassle" and "leakages" significantly affect beneficiaries' preference for six-monthly system and as "hassle" and "leakages" decrease in the system, beneficiary is more likely to prefer six-monthly system.

Similarly a step-wise selection procedure was applied on all the impeding variables listed in Table 2.4. All variables included in the model are listed in Table 2.6. Except for "timely distribution" and "PDS outlet distance" all other variables were significant at five percent. The significant explanatory variable "storage" has a coefficient estimate of 0.80 and exponent of 2.23 which suggests that all other explanatory variables held constant, the odds of success of preferring the six-monthly system when the beneficiaries perceive that "storage" is not a challenge is 2.3 times or 131.4% the odds of preferring system when they perceive that "storage" is a challenge. Other significant variables can be interpreted in similar way. These results suggest that if beneficiaries perceive that "storage" and "one-time payment" is a challenge they are less likely to prefer six-monthly system. Similarly, if they feel that six month is a long interval of time for grain distribution or in six-monthly system bulk grains are more likely to be traded by their family members or they are more vulnerable to getting exploited by middlemen or communication of stock arrival is not proper they are less likely to prefer six-monthly system. These factors significantly impact beneficiaries' preference for six-monthly system.

Table 2.6. Impeding factors regressed on the preference of beneficiary for six-monthly

distribution system (n = 195)

Variables	Estimate	Exponents	Standard error	Chi-square	Prob>chiSq
Storage	0.80	2.23	0.31	6.68	0.010***
Timely distribution	0.32	1.37	0.27	1.36	0.24
Long interval	0.88	2.42	0.43	4.33	0.037**
One-time payment	0.37	1.45	0.18	4.37	0.037**
Grains traded[a]	1.07	2.91	0.40	7.08	0.008***
Exploitation by middlemen[a]	1.09	2.97	0.35	9.87	0.002***
PDS outlet distance	0.62	1.85	0.45	1.84	0.17
Communication of stock arrival	0.59	1.80	0.19	9.94	0.002***
Intercept	-1.70	0.18	0.57		0.003***
McFadden's pseudo R^2	0.23				

Whole model test (-log likelihood difference 30.85, chi-square 61.69, prob>chisq <0.0001), lack of fit (-log likelihood difference 26.00, chi-square 52.00, prob>chisq 0.065), ***indicate statistical significance at 1%, ** indicate statistical significance at 5%

[a] Based on language of the question and beneficiary response these variables were reverse coded to fit the model

"Preference for six-monthly system" = 1 if respondents prefer six-monthly distribution system over monthly system, = 0 otherwise; "Storage" = 1 if respondents felt that storage of bulk grains in six-monthly system is not a challenge, = 0 otherwise; "Long interval" = 1 if respondents felt that six months is not a long interval of time for the grain distribution, = 0 otherwise; "One-time payment" = 1 if respondents felt that onetime payment during six-monthly system is not a challenge, = 0 otherwise; "Grain traded" = 1 if respondents felt that bulk grains will not get traded by him/her or any member of his/her family, = 0 otherwise; "Exploitation by middlemen" = 1 if respondents felt that with six-monthly distribution system they don't fear exploitation by hands of middle men, = 0 otherwise; "Communication of stock arrival" = 1 if respondents felt that communication regarding arrival of grains is proper with six-monthly system, = 0 otherwise.

Furthermore, a step-wise selection procedure was also performed on all demographic variables as listed in Table 2.3. All variables included in the model are listed in Table 2.7. Test statistics from regression run on suggested variables indicated the need for two way interaction terms. Further, "gender", "area", and "employment" were

significant at five percent. The significant explanatory variable "gender" has a coefficient estimate of -0.53 and an exponent of 0.59 which suggests that all other explanatory variables held constant, odds of success of preferring six-monthly system decreases by 41.2% when we switch from males to females or with all other explanatory variables held constant, odds of choosing six-monthly program by females are 0.59 times the odds of choosing six-monthly program by males. Other significant variables of "area" and "employment" can be interpreted in a similar way. These results suggest that females, beneficiaries from rural areas and housewives are less likely to prefer six-monthly system as compared to males, beneficiaries from urban areas and beneficiaries employed as casual labors respectively. Therefore "gender", "area" and "employment" significantly impact beneficiaries' preference for six-monthly system.

To evaluate the performance of six-monthly system, authors further analyzed all the significant variables identified above using one-sample Wilcoxon signed rank test (refer Table 2.8) (Robbins, 2010). The distributions of all individual responses on a Likert scale of −3 to +3 for a single variable were tested around zero. These results indicate that beneficiaries perceive that "hassle" and "leakages" have decreased with introduction of six-monthly system. They feel that "storage of bulk grains", "grains being traded by family members", "exploitation by middlemen" and "communication" is not a concern with six-monthly system. But they also feel that six months is a "long interval" of time for grain distribution and "one-time payment" is a challenge for them. Furthermore, there was insufficient evidence to conclude that the beneficiaries preferred either one or six-monthly system more than the other.

Table 2.7. Demographics factors regressed on the preference of beneficiary for six-monthly distribution system (n = 271)

Variables	Estimate	Exponents	Standard error	Chi-square	Prob>chiSq
Age	0.00	1.00	0.03	0.00	0.94
Gender[Female][a]	-0.53	0.59	0.24	5.02	0.03**
Area[Rural][a]	-3.51	0.03	0.96	13.32	0.0003***
Head of Family[Female][a]	0.16	1.18	0.33	0.25	0.62
SLI	-0.38	0.68	0.20	3.72	0.05
Experience with six-monthly system	0.04	1.04	0.03	1.52	0.22
Education	0.11	1.11	0.08	1.88	0.17
Employment[Casual labor][a, b]	0.88	2.41	0.34	6.82	0.009***
Age*Area[Rural]	-0.04	0.96	0.03	2.55	0.11
Gender[Female]*SLI	-0.21	0.81	0.13	2.55	0.11
Gender[Female]*experience with six-monthly system	0.05	1.05	0.03	2.3	0.13
Gender[Female]*education[c]	-0.10	0.90	0.03	8.92	0.003***
Area[Rural]*SLI	0.38	1.45	0.21	3.19	0.07
Area[Rural]*education[c]	-0.22	0.80	0.08	8.01	0.005***
Head of Family[Female]*employment	0.55	1.73	0.33	2.76	0.10
Intercept	3.73		1.62	5.27	0.02**
McFadden's pseudo R^2	0.25				

 Whole model test (-log likelihood difference 45.91, chi-square 91.82, prob>chisq <0.0001), lack of fit (-log likelihood difference 130.35, chi-square 260.70, prob>chisq 0.23), ***indicate statistical significance at 1%, ** indicate statistical significance at 5%

[a] Categorical variables with base category in parenthesis
[b] Employment was categorized into casual labor and housewives; data for self-employed was either excluded or case by case included within the two categories
[c] These interactions are significant e.g. gender[Female] X education suggests that slope for males and females are significantly different from each other given years of schooling vs. log odds of success. To make any interpretation for interaction terms we need to account for individual variables as well. There can be a different significance tests that can be performed but it is beyond the scope of this paper

Table 2.8. Distribution of individual significant variables around zero on a seven point

Likert scale of - 3 to +3

Variables	Estimated mean	Standard deviation	Wilcoxon signed rank test statistic	Prob
Hassle	1.26	1.18	17554.50	<0.0001***
Leakages	0.32	1.27	6621.00	<0.0001***
Storage	-0.80	1.65	-11561.00	<0.0001***
Long interval	1.29	1.68	17707.00	<0.0001***
One-time payment	0.35	0.68	3981.50	<0.0030***
Grains traded	-1.40	1.30	-17320.00	<0.0001***
Exploitation by middlemen	-1.08	1.48	-15338.0	<0.0001***
Communication of stock arrival	-0.95	1.53	-13890.0	<0.0001***
Preference for six-monthly system	0.25	1.91	2103.50	0.07

***indicate statistical significance at 1%

Discussion

Our findings suggest that of all the benefits claimed by the state government and

policy makers (refer Table 2.1), beneficiaries' preference for six-monthly system is

strongly influenced by their perception of decreased "hassle" and "leakages" in the

system. These two facilitating factors as identified in our study were consistent with the

observations of Gaikwad (2010), Kumar (2015), and Puri (2015). With "hassle" being

statistically significant, it strongly indicates that going to FPS on a monthly basis is not

convenient for beneficiaries and they prefer procuring their grains at an extended interval

of time. On the other hand, this might also suggest that beneficiaries less enjoy their

service experience with PDS and its stakeholders. About 53% of the beneficiaries

reported spending more than two hours to procure their grains and about 48% reported

being hourly employees or casual laborers. This might affect their perceived service quality which might further discourage them to engage with the system frequently.

Therefore, distribution at an extended interval such as six months results in increased consumer satisfaction as it saves a lot of productive time which has significant opportunity cost for the beneficiaries and might better help them concentrate on their employment or other welfare activities (Gaikwad, 2010; Kumar, 2015). Moreover, with public services functioning as monopolies policy makers tend to ignore the importance of customer satisfaction in policy implementation (Andreassen, 1994). These findings suggest that beneficiaries are rational consumers having preferences, expectations and constraints and they often make informed choices to maximize utility from the system. Their choice of a productive participation in the system can make such policy initiatives very successful. So a significant policy implication of the research finding is to integrate consumer satisfaction as an important performance indicator for such developmental policies.

Likewise, the current framework of six-monthly distribution system increases transparency in the system with improved mechanism of community distribution. Delivery of grains happen at common sites such as local temples or play grounds. So instead of interacting on an individual basis with FPS representatives, beneficiaries receive grains in front of other beneficiaries under direct supervision of food inspectors. Gaikwad (2010) suggested that this will decrease organized black marketing by middlemen as the system will have increased monitoring by the government and beneficiaries. A decrease in leakages this will have direct positive impact on quantity of grains being delivered to beneficiaries improving their consumption pattern as well

(Kishore & Chakrabarti, 2015; Rahman, 2016). So these findings suggests that a perception of decrease in leakages in the system translates into beneficiary having more trust in six-monthly distribution system thus beneficiaries' preference of policy greatly depends on their perception about the improvement in system's efficiency (Ramaswami & Balakrishnan, 2002). Furthermore, the established trust can increase beneficiaries' willingness to accept the changes proposed by the new scheme and become a part of its successful implementation. Therefore "trust in the system" should also be used as an important performance indicator for developmental policies at large.

This research also identifies that "storage", "interval of grain distribution", "one-time payment", "grains trade", "exploitation by middlemen" and "time between the communication and actual distribution of grains" significantly influences beneficiaries' preference for six-monthly distribution system. Though beneficiaries strongly suggest that "storage" is not a concern but it can significantly impact their preferences which contradict the observations of Gaikwad (2010). This study's results suggest that if beneficiaries feel that "storage" is a concern they are less likely to adopt six-monthly distribution system because more than 60% of them stay in temporary or make-shift houses so storing additional grains is a challenge. Further, Nayar (2015) and Sharma and Chandrasekhar (2016) suggested that beneficiaries either remain on move or frequently migrate in search of stable jobs which makes handling six-months storage impractical. Additionally, all the beneficiaries earn less than USD 896 per annum and proper storage of bulk grains require new infrastructural investments such as bins, bags or silos.

With "interval of grain distribution", if the beneficiaries perceive that six months is a long interval of time they are less likely to adopt the system. Our findings suggest

that beneficiaries strongly feel that six months is a long interval of time for grain distribution. This is more so because on most occasions the beneficiaries reported receiving grains after eight or nine months as against a deadline of six months. About 82% of the households report consuming their six month entitlement in less than four months leaving them with no food. So most of them believe that a longer interval will lead to more gap between distributions leaving them more vulnerable. At the same time they do not want to engage with the system as frequently as on a monthly basis. Thus if the system can efficiently deliver them grains on a six-monthly basis on a fixed pre-determined date, most of beneficiaries might not be as apprehensive about the interval of distribution. Delivering as committed will increase customer trust and satisfaction with the system.

"One-time payment" is a critical factor because most of the beneficiaries earn less than USD 2.5 per day. During monthly system the payment of grains was distributed equally over 12 months but with six-monthly system the beneficiaries have to pay for six months at once. More so, about 65% of them reported having no formal education which makes planning finances a challenge. Additionally, other interrelated factor is time between communication of arrival and actual distribution of grains. There is no fixed date of distribution and the communication for distribution happens about 12 hours before the actual arrival of grains. About one third of respondents reported dissatisfaction with the time frame and found it difficult to arrange for money and other resources for procurement. Hence the uncertainty in distribution of grains impact beneficiaries' preference drastically. Also beneficiaries feel that "grain trade by family members", and

"exploitation by middlemen" is not a concern for them in the present system. But they also feel that if this happens it will strongly influence their preference for the system.

Furthermore our research also identifies several demographic factors such as "gender", "area" and "employment" which significantly impacts beneficiaries' preference for six-monthly system. Several studies such as Abebe et al. (2013) and, Khera (2014) have identified similar demographic factors influencing policy adoption under different scenarios. Our study suggests that females are less likely to prefer six-monthly system as compared to male household members. This can be due to the fact that about 40% of the female respondents were housewives and did not contribute directly towards household income (Rao, 2006). Due to less financial independence it might be convenient for them to procure the grains on a monthly basis. When pattern of household members participating in PDS prior to six-monthly system was compared with the existing scenario it was found that the female engagement has decreased by about 54%. This might be a strong reason that females prefer six-monthly system less as it decreases their overall control to plan for household food security. Additionally 65% of female respondents had no formal education which makes understanding and adopting the new system a challenge.

Contrary to Gaikwad (2010) the results suggested that beneficiaries in rural areas are less likely to adopt six-monthly system as compared to urban beneficiaries. Since Gaikwad (2010) study is based in Maharashtra where villages in Western Ghats are not accessible by roads and average distance to market is 9~12 miles, six-monthly system is more favorable for beneficiaries. But the average distance to market in rural Punjab is 0.89 miles indicating that access to market is more convenient in rural Punjab. The

logistic resources such as transportation in urban areas are more costly as compared to rural areas. Moreover employment patterns such as organized labor are different in urban as compared to rural areas (Sharma & Chandrasekhar, 2016). Our results suggest that "employment" in general affects beneficiaries' preference for six-monthly system. Casual laborer or daily wage workers are more likely to prefer six-monthly system as compared to beneficiaries who are not employed. The respondents with no employment are mostly housewives as discussed before.

Study limitations and future work

There are several limitations of the study and first being that the data were collected using purposive snowball sampling. Though this method was appropriate given the field constraints but a stratified sample could give more credence to the generalization of research findings. Further, this research is focused on just one aspect of new atta-daal (wheat-pulses) scheme i.e. six-monthly distribution system for wheat. The impact of digitization of identification cards, and the impact of females being declared as the head of family still needs further investigation. Additionally, the research findings reflect the perception of just one of the stakeholders i.e. beneficiaries. Survey of policy makers, FPS owners, FCI officials and commission agents can add breadth to the research. Moreover, the data were collected after 18 months of the implementation of the policy i.e. from July'15 to Aug'16. With policy adoption initial few years are infant or early acceptance stage where the beneficiaries observe several teething issues. Their perception might evolve or change over the course of policy implementation. Though the research has specific geographic scope but the findings are critical and contribute significantly towards the larger international debate of food security. The results and methodology are

generalizable to investigate policy implications at broader level. Also during survey data collection in Aug'16 the state of Punjab was nine months away from state assembly elections. The election season might have influenced the beneficiary responses as well. And as per the policy requirements the six-monthly system was optional for beneficiaries but majority of beneficiaries were not aware and their responses could have been influenced by the perception of the six-monthly system as an obligation.

The future work on this research can include an increased sample size which is spread across several districts. Structure equation modelling and factor analysis can be used for understanding individual factor loadings and degree of influence of each variable. A techno-economic analysis of the six-monthly supply chain can yield a cost benefit ratio and help understand policy implementation better. This would be critical to weigh the sustainability of policy in long run.

Conclusions

This research identifies facilitating, impeding and demographic factors which affect beneficiaries' preference for six monthly distribution system and also evaluates performance of the new system based on these identified factors. Further, it discusses generalized policy implications and makes recommendations for developmental policies at large. Findings of this research will be significant for developing economies such as Bangladesh, which run similar public food distribution systems.

Factors affecting beneficiaries preference for six monthly system include "hassle", "leakages", "storage", "interval of grain distribution", "one-time payment", "grain trade", "exploitation by middlemen", "communication", "age", "gender" and "employment". Beneficiaries believe that with six-monthly system "hassles" and

"leakages" have decreased but "interval of grain distribution" and "one-time payment" is a challenge for them. Since the last two factors considerably affect beneficiaries' preference the policy makers need to plan necessary interventions.

Some of the important generalizable policy implications based on this research are that (1) decentralization is critical for the success of food policies and these systemic interventions will be effective only if they are strongly grounded in relevant needs of beneficiaries and supported by administrative efforts and rigor, (2) such interventions should not undermine the status of beneficiaries as a rational consumer and policy makers should realize the importance of consumer satisfaction in successful implementation of similar developmental policies, (3) beneficiaries' trust on the system defines his/her willingness to accept the policy interventions and participate to make it successful; delivering on commitments by administration can help strengthen beneficiaries' trust on the system, and (4) communication with beneficiaries and other stakeholders regarding new developments is critical for policy's success; ambiguity and uncertainty due to lack of transparency can be detrimental to such policy interventions.

Specifically for six monthly distribution system it is recommended that (1) beneficiary trust and satisfaction should be made key policy performance indicators, (2) the government should provide logistical support to beneficiaries in form of bins, or hermetic storages such as PICS (Purdue Improved Cowpea Storage) bags for storing six month entitlement, (3) option of cash advance for monetary resilience of beneficiaries via FPS will be really useful, (4) since promoting females as head of the families is one of the prime objective of new atta-daal (wheat-pulses) scheme under NFSA 2013, gender based incentives for females can increase their engagement with the system, (5)

distribution of grains should happen on fixed pre-determined dates communicated well in advance; the state should make every effort to deliver grains on time and (6) furthermore, this scheme should be implemented with an option to revert back to a monthly distribution system when desired by beneficiaries and this should be clearly communicated to them.

References

Abdul- Quader, A. S., Heckathorn, D. D., McKnight, C., Bramson, H., Nemeth, C., Sabin, K., & Des Jarlais, D. C. (2006). Effectiveness of respondent-driven sampling for recruiting drug users in New York City: findings from a pilot study. *Journal of Urban Health, 83*(3), 459 – 476.

Abebe, G. K., Bijman, J., Kemp, R., Omta, O., & Tsegaye, A. (2013). Contract farming configuration: Smallholders' preferences for contract design attributes. *Food Policy, 40*(13), 14 – 24.

Agresti, A. (2007). *An introduction to categorical data analysis*. New Jersey, NJ: John Wiley & Sons, Inc.

Andreassen, W. T. (1994). Satisfaction, loyalty and reputation as indicators of customer orientation in the public sector. *International Journal of Public Sector Management, 7*(2), 16 – 34.

Balani, S. (2013). Functioning of the Public Distribution System, an analytical report. *PRS Legislative Research*. Retrieved from http://www.prsindia.org/administrator/uploads/general/1388728622~~TPDS%20 Thematic%20Note.pdf

Berning, J. P., Chouinard, H. H., Manning, K. C., McCluskey, J. J., & Sprott, D. E. (2010). Identifying consumer preferences for nutrition information on grocery store shelf labels. *Food Policy, 35*(10), 429 – 436.

Chopra, S. (2014). *Topics in food security: measuring performance and technology adoption in the public distribution system supply chain of Chhattisgarh, India* (Doctoral dissertation). Retrieved from Purdue library. (AAI3668781)

Clark, W. A., & Hosking, P. L. (1986). *Statistical Methods for Geographers*. New York: Wiley.

Creswell, J. W. (2009). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.

Dept. of food civil supplies & consumer affairs, Government of Punjab. (2014). *New Atta Dal Scheme*. Retrieved from http://foodsuppb.nic.in/newattadal.html

Dept. of food civil supplies & consumer affairs, Government of Punjab. (2014a). *Eligibility Criteria*. Retrieved from http://foodsuppb.nic.in/files/FSAct/Eligibility%20criteria.pdf

Domencich, T. A., & McFadden, D. (1975). *Urban travel demand: Behavioral analysis*. Amsterdam: North-Holland.

Economic & statistical organization. (2013). *Statistical Abstract of Punjab*. Chandigarh, Punjab: Government of Punjab.

Ekstrom, J. (n. d.). *The phi-coefficient, the tetrachoric correlation coefficient, and the Pearson-yule debate*. Retrieved from The%20Phi-coefficient,%20the%20Tetr...d%20the%20Pearson-Yule%20Debate.pdf

FAO. (2015). *The state of food insecurity in the world*. Retrieved from http://www.fao.org/3/a-i4646e.pdf

Food Corporation of India. (2016). *Procurement – policy and system*. Retrieved from http://fci.gov.in/procurements.php?view=86

Gaikwad, S. (2010). Scheme for home delivery of food grains – a successful experiment under public distribution system. *Yashwantrao Chavan Academy of Development Administration*, *Best Practice Series One.* Retrieved from http://sheetalkachare.ucoz.com/Scheme_for_Home_Delivery_of_Foodgrains.pdf

Greene, W. H., (2008). *Econometric Analysis*. Boston, MA: Pearson.

Grover, A. K., Chopra, S., & Mosher, G. A. (2016). Food safety modernization act: A quality management approach to identify and prioritize factors affecting adoption of preventive controls among small food facilities. *Food Control, 66*, 241 – 249.

Hosmer, D. W., & Lemeshow, S. (2000). *Applied Logistic Regression*. New York, NY: John Wiley & Sons, Inc.

Jain, S. P., & Polman, W. (2003). A handbook for trainers on participatory local development -The panchayati raj model in India. *Food and Agriculture Organization*. Retrieved from ftp://ftp.fao.org/docrep/fao/006/ad346e/ad346e00.pdf

Kabir, H., Yegbemey, R. N., & Bauer, S. (2013). Factors determinant of biogas adoption in Bangladesh. *Renewable and Sustainable Energy Reviews, 28*(13), 881 – 889.

Khera, R. (2011). Trends in diversion of PDS grain. *Economic and Political Weekly*, *46*(21), 106 – 114.

Khera, R. (2014). Cash vs. in-kind transfers: Indian data meets theory. *Food Policy, 46*(14), 116 – 128.

Kishore, A., & Chakrabarti, S. (2015). Is more inclusive more effective? The 'New Style' public distribution system in India. *Food Policy, 55*, 117 – 130.

Kumar, S. (2015). Report of the high level committee on re-orienting the role and restructuring of Food Corporation of India. *Government of India*. Retrieved from http://www.fci.gov.in/app2/webroot/upload/News/Report%20of%20the%20High %20Level%20Committee%20on%20Reorienting%20the%20Role%20and%20Re structuring%20of%20FCI_English_1.pdf

Long, S.T., & Freese, J. (2006). *Regression model for categorical dependent variables using stata*. College Station, Texas: A Stata Press Publication.

Longhurst, R. (2003). Semi-structured interviews and focus groups. In *Key methods in geography* (chapter 9). Thousand Oaks, CA: Sage Publications.

Ministry of Consumer Affairs, Food & Public Distribution, Government of India. (2011). *Number of Ration Shops in the Country* [Data file]. Retrieved from http://pib.nic.in/newsite/PrintRelease.aspx?relid=74180

Ministry of Consumer Affairs, Food & Public Distribution, Government of India. (2016). *Targeted Public Distribution System.* Retrieved from http://dfpd.nic.in/public-distribution.htm

Namara, R.E, Nagar, R. K., & Upadhyay. B., (2007). Economics, adoption determinants, and impacts of micro-irrigation technologies: empirical results from India. *Irrigation Science, 25*, 283 – 297.

Nayar, L. (2015, January 27). Five important questions on food security. *Outlook*. Retrieved from http://www.outlookindia.com/website/story/five-important-questions-on-food-security/293207

Neuendorf, K. A. (2002). *The Content Analysis Guidebook*. Thousand Oak, CA: Sage.

Puri, A. (2014, May 2). A grain of sense – how Punjab is making the best use of the flawed public distribution system. *The Indian Express*. Retrieved from http://indianexpress.com/article/opinion/columns/a-grain-of-sense/

Rahman, A. (2016). Universal food security program and nutritional intake: evidence from the hunger prone KBK districts in Odisha. *Food Policy, 63*, 73 − 86.

Rajan, P., Chopra, S., Somasekhar, A. K., & Laux, C. (2016). Designing for food security: portability and the expansion of user freedoms through the COREPDS in Chhattisgarh, India. *Information Technologies and International Development, 12*(3), 1 − 18.

Ramaswami, B., & Balakrishnan, P. (2002). Food prices and the efficiency of public intervention: the case of the public distribution system in India. *Food Policy, 27*(5), 419 − 436.

Rao, N. (2006). Land rights, gender equality and household food security: exploring the conceptual links in the case of India. *Food Policy, 31*(2), 180 − 193.

Robbins, B. H. (2010). Non parametric tests − scholar series. Retrieved from http://biostat.mc.vanderbilt.edu/wiki/pub/Main/AnesShortCourse/NonParametrics.pdf

Sharma, A., & Chandrasekhar, S. (2016). Impact of commuting by workers on household dietary diversity in rural India. *Food Policy, 59,* 34 − 43.

Sharma, P. (2016, April 19). Punjab dug into central funds to bankroll atta-dal scheme. *Hindustan Times*. Retrieved from http://www.hindustantimes.com/punjab/punjab-dug-into-central-funds-to-bankroll-atta-dal-scheme/story-IumLMWW2hQcLb2mfxyEBwJ.html

Stebbins, R. A. (2001). *Exploratory Research in Social Sciences*. Thousand Oaks, CA: Sage Publications.

Tey, Y.S., Li, E., Bruwer, J., Abdullah, A.M., Brindal, M., Radam, A., Ismail, M.M., & Darham, S. (2014). The relative importance of factors influencing the adoption of sustainable agricultural practices: A factor approach for Malaysian vegetable farmers. *Sustainability Science, 9*(1), 17 − 29.

Tiwari, K. R., Sitaula, B. K., Nyborg, I.L.P., & Paudel, G. S. (2008). Determinants of farmers' adoption of improved soil conservation technology in a middle mountain watershed of central Nepal. *Environmental Management, 42*, 210–222.

Tribune news service. (2015, April 3). Food grains to be distributed to BPL families twice a year, says Kairon. *The Tribune*. Retrieved from http://www.tribuneindia.com/news/punjab/governance/foodgrain-to-be-distributed-to-bpl-families-twice-a-year-says-kairon/64285.html

Weems, G. H., & Onwuegbuzie, A. J. (2001). The impact of midpoint responses and reverse coding on survey data. *Measurement and Evaluation in Counselling and Development, 34*(3), 166.

Wu, S. (2013). A review on coarse warranty data analysis. *Reliability Engineering and System Safety, 114*(13), 1 − 11.

CHAPTER 3. A MULTI-OBJECTIVE DECISION ANALYSIS OF SIX MONTHLY DISTRIBUTION SYSTEM FOR FOOD GRAINS IN PUBLIC DISTRIBUTION SYSTEM OF PUNJAB, INDIA

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Abstract

The government of Punjab, India in 2014 made amendments to the existing public distribution system of food grains by launching "new atta-daal (wheat-pulses) scheme". Instead of distributing subsidized food grains on a monthly basis to its below poverty line citizens the state started distributing grains on a six monthly basis (semi-annually). With new scheme the state claimed several logistical and monetary benefits to the system whereas beneficiaries voiced concerns with grain handling and one-time payments. Due to conflicting effects on multiple stakeholders this new scheme required a formal analysis of different policy alternatives. This research paper presents the application of multiple objective decision analysis to evaluate possible alternatives of grain distribution for the beneficiaries of public distribution system for the district of Ludhiana in Punjab, India. We first develop an "objectives hierarchy" and "measures" for the decision problem using emergent codes from qualitative data collected via semi-structured interviews, focus group discussions and guided conversations with 40 participants representing seven different stakeholders. We then assess weights to identify relative importance of these

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measures by using swing weight method. Thereafter we identify and discuss five feasible "alternatives" for six monthly interval of grain distribution (status quo) such as quarterly distribution, annual distribution, the old one monthly system, a one monthly system with new regulations and an improved six monthly distribution system. Furthermore we gather data for performance of all alternatives against each measure by conducting Likert scale surveys of over 300 beneficiary households across 14 different villages (rural) and localities (urban) of Ludhiana district in Punjab. Then we develop single-measure utility functions, using which we calculate multi-measure utility functions for all alternatives assuming additive operations to identify the best performing alternative. Finally, sensitivity analysis is performed to establish robustness of the suggested solution.

Introduction

According to Food and Agricultural Organization (FAO) (2015), approximately 795 million people around the world are suffering from acute hunger and majority of which are in developing countries such as India. To deal with the problem government of India started one of the largest public programs of distributing subsidized food grains and other commodities to its pre-identified below poverty line (BPL) citizens called the Public Distribution System (PDS) (Kishore & Chakrabarti, 2015). Inefficiencies of PDS supported by corrupt practices and inadequate storage facilities result in a loss of 58.6% of the total procured grains and off the remaining that reaches the intended population many beneficiaries complain about quality, quantity and price distortions along with inclusion and exclusion errors (Bajaj, 2012; Balani, 2013; Rajan et al., 2016). The responsibilities of PDS are shared between the state and the federal government with states entrusted with identification of beneficiaries and distribution of procured grains. To

tackle the inefficiencies of PDS the state of Punjab introduced new atta-daal (wheat-pulses) scheme in 2014 which was developed using the guidelines of National Food Security Act (NFSA) 2013 (Dept. of Food Civil Supplies & Consumer Affairs, 2014). Provisions of the scheme overhauled the existing supply chain of food grain distribution (refer Table 3.1). Prior to the scheme beneficiaries visited state designated fair price shops (FPS) on a monthly basis to procure their entitlement of wheat, pulses and other commodities. Among other requirements the state decided to distribute the grains on a six monthly basis (semi-annually) instead. Government claimed that the new scheme will not only enable an annual saving of USD 25.4 million for the state and but will also improve the overall experience of beneficiaries with the PDS (Puri, 2014). But contrary to the claims made by the state government an exploratory visit with beneficiaries suggested several concerns. Since the beneficiaries received six months of grains at one go, an average beneficiary household was handling six to seven times more grains than before. Many policy analysts referred to this as a forward storage mechanism wherein the government was making the beneficiaries store and preserve the grains on their behalf (Gaikwad, 2010). Most of these beneficiaries lacked proper storage facilities and were constantly migrating in search of better jobs thereby making grain handling much difficult (Grover & Chopra, 2017). Beneficiaries also had concerns with increased one-time payment and untimely distribution frequency (refer Table 3.1). This raised serious concerns with "six months" distribution interval suggesting scope of evaluating alternate intervals of grain distribution using formal decision analysis.

Table 3.1. Provisions of new atta-daal (wheat pulses) scheme along with its intended benefits and beneficiary feedback

Provisions of new scheme[a]	Suggested benefits	Beneficiary feedback [b]
Eldest woman will be head of family	Women empowerment; enhanced food security for children	*"...six monthly system more inaccessible for females as large quantity of grains, money involved..."*
Eligible beneficiaries will be identified on basis of unique identification (UID) number	Reduction in inclusion and exclusion errors	*"...mushrooming of middlemen charging for UID applications..."*
Wheat will be distributed at USD 0.03 per kg	Improved purchasing capacity	*"...rates increased to USD 0.06 per kg..."*
Every household member will get 5 kg wheat per month without any upper cap	Improved consumption pattern	*"...sufficient grains not available for purchase against entitlement..."*
Unsatisfied beneficiary can go to a consumer court	Grievance redressal	*"...beneficiaries less aware of their rights..."*
Entitlement of wheat will be given to beneficiaries on a biannual or six-monthly basis	Improved quantity and quality of grains; decreased hassle for beneficiary; less state expenditure	*"...grain handling difficult; one time cost increased; long interval; untimely distribution frequency..."*
Distribution of grains will be done under direct supervision of food, civil supplies department	Increased vigilance; decreased leakages	*"...distribution work delegated to fair price shop owners..."*
Wheat will be distributed in 30kg sealed bags equivalent to six months entitlement of a beneficiary	Improved quantity; consumer empowerment	*"...open bags distributed sometimes..."*
Door step delivery instead of fair price shops	Improved delivery mechanism; leakages decreased	*"...distribution frequency irregular..."*
Distribution of grains immediately after procurement	Reduced storage and preservation cost for Govt; reduction in wastage; improved quality of grains	*"...distribution frequency irregular..."*

[a] Dept. of food civil supplies & consumer affairs, Govt. of Punjab (2014)
[b] Collected by analyzing author's exploratory research visit data

This research is an extension of authors' earlier work on understanding factors affecting preference of beneficiaries for six monthly distribution of food grains (Grover & Chopra, 2017). While the primary objective of this research work is to identify and understand several possible alternatives to "six monthly" interval of grain distribution and suggest the best solution to policy makers with respect to beneficiaries but secondary objective of this work is also to demonstrate how techniques of multi-criteria decision analysis (MCDA) can facilitate complex decision making during policy formulation and analysis with respect to food distribution in developing countries such as India.

Several research articles have highlighted the basis of integrating a decision analysis approach to policy formulation and analysis. Almeida and Bascolo (2006) conducted a comprehensive meta-analysis on the existing literature for policy and decision making and summarized the available models based on their approach as a) rational approach (knowledge driven and problem solving), b) strategic approach (political and tactical) and, c) diffusion approach (interactive and intellectual). They differentiated traditional from non-traditional approach by highlighting that traditional approach assumes policy formulation and decision making as a linear process based on a series of rational decisions made by so called privileged actors where-as the non-traditional approaches such as MCDA lay greater emphasis on integration and interaction of decision makers and beneficiaries.

Furthermore Gregory et al. (2005) highlights the valuable attributes of formal decision analysis procedure for public policies. Emphasizing the challenges with public policy making such as multiple interest, volatility, conflicts and complexity which they feel if not addressed appropriately can undermine the fundamentals of democratic

decision making. Gregory et al. (2005) suggest that decision analysis approach can address these challenges as it is interactive, disciplined, grounded in behavioral research. They further emphasize that policy decisions reached through decision analysis have greater chances of being acceptable among beneficiaries thereby generating much favorable outcomes. Walker (2000) demonstrates the use of a formal decision analysis process for policy making by suggesting that real-world policy situations have several alternatives, many uncertainties, multiple stakeholders and infinite consequences. Such operation research tools such as decision analysis help disintegrate complex problem and make the information more palatable for researchers and policy makers to make informed decisions. Walker (2000) further suggests that the decision analysis in policy requires customer based view where-in there is a need to understand the beneficiaries of the policy before formulating it. There is substantial literature available on integration of decision analysis techniques with policy formulation and analysis but there is limited research on application of multi-criteria decision making for food policy analysis in developing countries. There is a need to utilize structured problem solving techniques for policy analysis to aid decision makers in informed decision making.

Several research papers present different frame works of multi-criteria decision analysis for policy formulation and analysis. Walker (2000) suggests general framework for policy analysis for MCDA a) identify the problem, b) identify the objectives, c) decide on criteria for measure of performance and cost for evaluating alternatives, d) select the alternative policies to be evaluated, e) analyze each alternative, f) compare the alternatives in terms of measures, g) implement the chosen alternative and h) monitor and evaluate results. There are several deviations in literature from this general framework

allowing for integration of contextual variability. Chien and Sainfort (1998) used MCDA to assess micro scale food policy issues such as desirability of meal portfolios for nursing home residents. They suggested that apart from the steps mentioned above defining objectives and identifying key qualitative attributes are critical for alternative assessment. Feng and Keller (2006) on the other hand introduced another step to the existing MCDA technique of identifying the value gaps for comparing the status quo and assuming a hypothetical perfect world situation. This helped them prioritize the improvements required for developing possible alternatives. They also integrated a feedback approach for their model to develop robust alternatives. Daviter (2013) suggested integration of informal methods of data collection especially for understanding policy dynamics.

Based on these general frameworks several other structural methods have been used for policy analysis. Saaty and Zoffer (2012) used analytical hierarchy process (AHP) to analyze complex foreign policy issues of Middle East conflict. According to the authors AHP allows for pairwise comparisons of alternatives against each measure and is less abstract. On the other hand Dyer (2005) suggests use of multi-attribute utility theory (MAUT). The author suggests that MAUT is based on detailed quantitative structure yet allows to incorporate qualitative factors with uncertainties. It uses utility functions to develop insights into each alternative allowing for the use of sensitivity analysis (Keeney and Raiffa, 1976). Literature illustrates several other methods that have been developed to solve for MCDA problems such as analytic network process (ANP), ELECTRE, value analysis (VA) etc. but authors use MAUT method due to its ability to provide simplified solutions for complex problems.

We address the following questions in this paper:

1) *What role can decision analysis techniques such as MCDA play in food policy analysis for developing countries to tackle issues of global food security?* As discussed before the policy makers in developing countries have to take tough decisions in unfavorable political and social environment with limited resources. There are risks and uncertainties associated with the decisions. This paper uses multi-attribute utility theory (MAUT) to show that decision analysis techniques can effectively facilitate decision making in such constrained environment. This research paper provides insights into a real world application of MCDA with significant suggestions to the policy makers.

2) *What MCDA framework can be implemented for food policy analysis in the developing countries' context?* There are several structural frameworks that literature has used for various fields of policy analysis. In this paper we utilize the conventional framework of policy analysis and decision making as in Fig 3.1. We integrate qualitative research techniques such as exploratory research and Likert based survey with the MAUT model.

Methodology

This research was conducted using nine sequential and/or parallel steps of MAUT methodology as illustrated in Fig 3.1. Authors integrated qualitative research methods of exploratory research with MAUT to a) define the problem statement, establish its boundary and characteristics, b) to determine the objectives and measures, c) to assign weights to each measure and d) identify possible alternatives (Sanayei et al., 2008). Authors used archival research, field visits, guided conversations, semi-structured interviews, and focus group discussions to inform the exploratory stage (Stebbins, 2001). After measures were explicitly defined these were used to design a survey which was

disseminated among 300 beneficiary households among 14 different villages and localities in district of Ludhiana across several socio-economic backgrounds using snowball sampling. Survey provided performance of each identified alternative against different measures of objectives as perceived by the beneficiaries. There after multi-measure utility functions were analyzed to evaluate alternatives and a sensitivity analysis was conducted to establish robustness of the solution.

Exploratory research

After thorough study of existing PDS literature authors visited Punjab – India from July to August, 2015 and spent over 40 days in field conducting exploratory research in three districts of Punjab i.e. Amritsar, Jalandhar, and Ludhiana. These districts were selected based on volume of beneficiaries served (Economic & statistical organization, 2013). During the visit, firstly archival research was conducted wherein authors collected information from state libraries and exiting literature available locally such as regional newspapers (Chopra, 2014). Based on archival research authors identified stakeholders as beneficiaries, FPS representatives, state government, dept. of food civil supplies & consumer affair - Punjab, Food Corporation of India (FCI), state procurement agencies, commission agents, and Punjab state agricultural marketing board (PSAMB). The stakeholder salience model was used to define the stakeholder attributes and categorize them for "six monthly" policy decision problem (Mitchell et al., 1997).The stakeholder attributes were power, urgency and legitimacy. According to the model beneficiaries were identified as "dependent" stakeholder as per the existing decision making dynamics but for rational policy analysis beneficiaries should be "definitive" stakeholders (refer to Table 3.2).
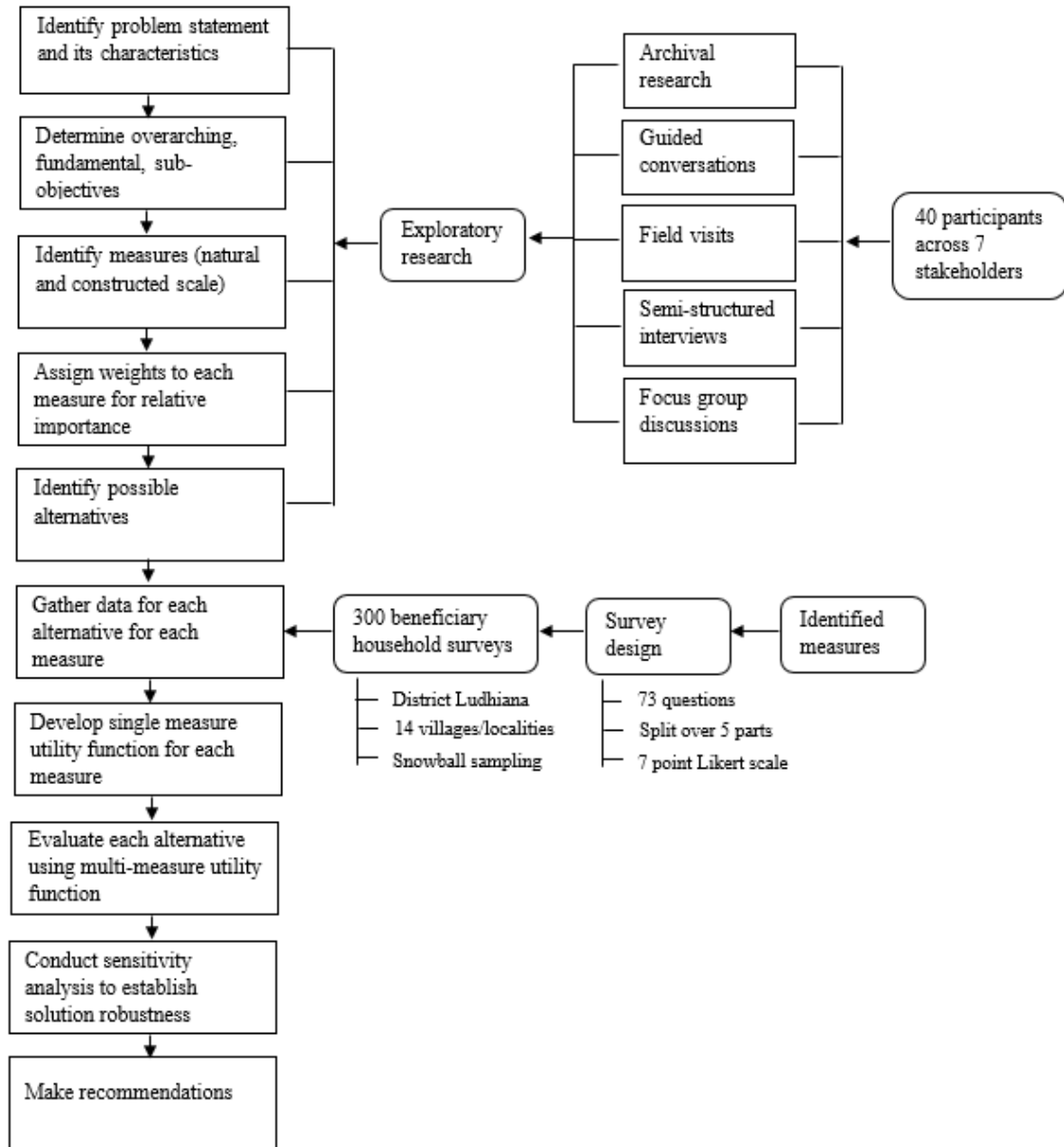
Figure 3.1. An illustration of Multi-attribute utility theory (MAUT) approach used for the research

Once the stakeholders and their relative importance was identified, authors used techniques such as a) focus group discussions to collect a range of opinions and ideas, and b) semi-structured interviews using open-ended questions to stimulate discussions (Sayanei et al., 2008). Authors used field notes, minutes of meeting, audio and video

recordings to collect field data and documented 55 hours of observation with over 40 interviews with all the identified stakeholders (Grover et al., 2016). The data was transcribed and emergent codes were grouped into common themes to identify system requirements, objectives and measures. These measures were later used to design the survey. Authors used the input from all identified stakeholders to establish objectives hierarchy, identify measures, assign weights to measures and identify alternatives. Understanding the importance of beneficiaries' role in decentralized policy making authors used only beneficiaries' perspective to measure the performance of each alternative against the identified measures using surveys[1] (Jain & Polman, 2003).

Table 3.2. Stakeholder salience model analysis

Stakeholders	Power	Urgency	Legitimacy	Type
Beneficiary	-	X	X	Dependent
Fair price shop (FPS)	-	-	X	Discretionary
State Government	X	X	X	Definitive
Food corporation of India (FCI)	-	-	X	Discretionary
State procurement agencies	-	-	X	Discretionary
Commission agents	-	-	-	Non-stakeholder
Punjab state agricultural marketing board (PSAMB)	-	-	X	Discretionary
Dept. of Food civil supplies & consumer affair, Punjab	-	X	X	Dependent

X – Applicable, otherwise not applicable

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[1] State government implemented the six monthly distribution system in 2014 with limited feedback from beneficiaries. Authors assume that since government already implemented the six monthly distribution system this is the best alternative according to them. Understanding the importance of beneficiaries' feedback, this research aims to capture beneficiary perspective in particular.

Developing the objectives hierarchy

An objective hierarchy was developed to identify the desirable characteristic requirements of the system and to establish a directional relationship between goals, fundamental objectives, sub-objectives and performance measures (Feng & Keller, 2006). Stakeholder inputs, PDS program objectives and technical performance measures were used from the exploratory research to determine the objectives at different levels. Top-down approach was used to construct the hierarchy as the alternatives were not pre-specified (Wei et al., 2005). An overall objective was identified followed by fundamental objectives and then other lower tier sub-objectives. This process was continued until reasonable evaluation measures were defined.

Several fundamental objectives were conflicting and could be traded off among themselves such as delivering system efficiency and system cost. The objectives hierarchy helped guiding information collection and identifying alternatives. The objectives established were all measurable using beneficiary perception on a seven point Likert scale. Measures were generally "constructed scale" which were developed particularly for MAUT analysis (Feng & Keller, 2006). Rating scales were created for Likert measures of a negative three to a positive three ranging on three levels from least preferred to most preferred outcome from beneficiaries' preference.

After identifying the objectives and system requirements a functional analysis was performed using an integrated definition for function modeling (IDEF0) (Kim & Jang, 2002). The functional analysis helped in systematically identifying, describing and relating different functions the public distribution supply chain system must perform in order to meet the identified requirements and objectives. Functional analysis facilitated in

identifying system functions, inputs, outputs, different system constraints and guidelines.
This also helped in visually establishing sequential flow of the system and role of
different stakeholders during different stages. Authors used IDEF0 to better the
understanding of system and identify different alternatives (refer Fig 3.3).

Developing weights for each measure

Swing weight method was used to develop weights for all measures to identify
relative importance (Feng and Keller, 2006; Ferretti et al., 2014). This is a bottoms up
approach as individual measures are compared pairwise to establish relative significance
of measures for different stakeholders. Firstly the measures were ranked relative to each
other. These rankings were given by the authors in multiple brainstorming sessions.
Authors used input from exploratory research, stakeholder feedback from semi-structured
interviews, and their personal field experience to form a mutual consensus about the
relative ranking of these measures. Some of the measures whose relative ranking was
ambiguous were given the same ranks such as transportation and redressal perception.
Hundred points were assigned to the highest ranked measure and then relative to the
highest rank measures, significance of lower ranked measures were established (refer
Table 3.4). Furthermore, relative weights on each measure were calculated by dividing its
assigned points by the sum total of all the points for every measure. e.g. female
participation 70/1660 = 0.04 and cost perception 95/1660 = 0.06. Sum of all the swing
weights is one.

Identifying different alternatives

A wide range of alternatives were considered for "six monthly" distribution of
food grains. Authors used objectives hierarchy and IDEF0 diagram to inform the process

of alternative identification. Best practices were also benchmarked among other exemplary states such as Chhattisgarh, Tamil Nadu and Maharashtra (Balani, 2013). The six monthly policy was discussed with several stakeholders including the beneficiaries, fair price shops, and government representatives to incorporate multiple perspectives. Idea generation techniques of brainstorming and focus group discussions were used with these stakeholders. A focus group discussion protocol was followed where-in no participant was allowed to criticize the other. A wide a range of ideas were discussed without judging the ideas and participants were allowed to build on each other's ideas. The focus group discussion was mediated by the authors and every participant was made aware of their rights and protocols (Creswell, 2013). Authors' collected and analyzed the data via exploratory research methods discussed in section "Exploratory research". Ideas were further screened on the basis of their ability to meet critical beneficiary requirements. The objective was to screen out less desirable and unfeasible alternatives. Identified alternatives were all comparable yet representative of a broad range of viable options. All dominated options were removed from the list.

Survey design and data collection

Once the alternatives were identified, data was collected for each measure with respect to these alternatives. Authors designed a survey using the measures identified in section "Developing the objectives hierarchy". The survey questions comprehensively illustrated all the measures with respect to two alternatives i.e. old one monthly distribution system and current six monthly distribution system. For other alternatives authors used the observations from exploratory research to extrapolate the performance with regard to these measures. Survey guidelines were used from data collection

instrument developed and validated by Khera (2014). The survey had 73 close-ended questions based on a seven point Likert scale[1] (Neuendorf, 2002). The questionnaire was validated using face validity and pretested among 15 beneficiaries (Chopra, 2014; Neuendorf, 2002). Authors visited Punjab – India again from July to August, 2016 to conduct the survey among eligible beneficiary households. The district of Ludhiana was selected for survey dissemination as it is the largest district of Punjab with the highest number of FPS and beneficiary households. About 300 surveys were administered across 14 villages and localities in the district, spanning over 29 days. Every survey took approximately 45~50 minutes. Given the political environment, it was difficult to capture the probability distributions so the authors did not evaluate uncertainty[2].

Participant of the survey were identified using snowball sampling from eight rural villages and six urban areas (Grover & Chopra, 2017). Their survey responses were kept anonymous. The respondent's gross household income was less than USD 896. Please refer Table 3.3 for participant profile of 300 beneficiaries.

Survey responses were analyzed using Microsoft Excel® after data cleaning. A master sheet was developed and all the responses for 300 beneficiaries was entered against the measures and alternatives respectively (Grover & Chopra, 2017). An average of all the 300 responses for individual measure was taken e.g. Likert scale response for female participation was averaged for all 300 participants for all the alternatives. These averaged Likert scale scores ranging between negative three to positive three were scaled to a score of zero to ten. This allowed for simplification of response functions and made

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[1] Seven point Likert scale ranges from -3 to +3 where -3 refers to strongly disagree, +3 refers to strongly agree and 0 refers to a neutral response
[2] During data collection Punjab was nearing state elections and the political environment was unpredictable. Uncertainties related to the political environment were difficult to capture so authors did not take these uncertainties into account.

data interpretation easier e.g. if the average score of 300 responses on the Likert scale for a measure was less than or equal to negative one, the response was scaled as zero or ten depending upon the direction of preference. Similarly if Likert response was between negative one to positive one the response was scaled to five and if the Likert scale response was more than equal to positive one it was scaled to zero or ten depending upon the direction (refer, Table 3.5 and Table 3.6).

Table 3.3. Characteristics of the survey respondents and their households

Characteristic	Number	Percent (%)
Age (years)		
21 – 30	42	14.00
31 – 40	114	38.00
41 – 50	86	28.67
51 – 60	33	11.00
≥ 61	25	8.34
Gender		
Male	102	34.00
Female	198	66.00
Education		
No education	79	26.33
$\leq 5^{th}$ Grade	116	38.67
Secondary (10th Grade)	85	28.33
Higher secondary (12th Grade)	18	6.00
College	2	0.67
Employment		
Casual Labor	143	47.67
Self-employed	61	20.34
Housewife	80	26.67
Area		
Rural	201	67.00
Urban	99	33.00
Avg. family size	4.86	
Avg. distance from PDS outlet (miles)	0.89	

Developing single measure utility functions

The objective of using single measure utility function (SUF) is to convert score on each measure to a common zero to one scale. Linearity or proportionality is the default

assumption of an SUF (Feng & Keller, 2006). A linear function was used as the survey

was designed on a Likert scale and the scale uses linearity as an inherent assumption. On

a scale of zero to ten the value difference from one to two has the same value in utility as

value difference from nine to ten i.e. the utility functions had neither decreasing rate

value nor increasing rate or even a combination of them. Given the complexity of the

decision problem assuming linearity simplified the development of utility functions. The

scaled up values (zero to ten) of Likert responses (negative three to positive three) were

used to assess SUF as discussed in section "Survey design and data collection" (refer

Table 3.7). The least preferred (zero) and most preferred (ten) values were used as

endpoints and the following equation was used to calculate utility score of value x_i as:

$$U_i(x_i) = \frac{(x_i - worst\ value)}{best\ value - worst\ value} \quad i.e. \quad U_i(5) = \frac{(5-0)}{10-0} = 0.5 \tag{1}$$

Where,

x_i is the scaled up value of the average of 300 household responses on a seven point
Likert scale, worst value is 0, best value is 10

Developing multi-measure utility functions

Once the relative weight of each measure was assessed and the SUF was

developed authors used additive value function to analyze multi-measure utilities for each

alternative (refer Fig. 3.4) (Feng and Keller, 2006; Ferretti et al., 2014). Authors assumed

a reasonable mutual preferential independence for each utility function for using additive

value function. Combining different weights and single attribute utility functions the

additive value function can be written as below:

$$U(x_1, x_2, \ldots, x_n) = \sum_{i=1}^{n} w_i\, U_i(x_i) \tag{2}$$

Where,

$U(x_1, x_2 ..., x_n)$ is the overall utility for an alternative
x_i is an alternative's performance on the ith objective
w_i is the weight assigned to the ith objective
and $U_i(x_i)$ is the single measure utility function for the ith objective

Sensitivity analysis

Alternative with the highest overall utility value is generally considered as the solution for the decision problem. Using "results ranking method" model was verified again to check for incorrect data entry, reverse scaling and range of utility scores. Relative strength of a few highly ranked alternatives were compared with each other. A value enhancement could be performed on the given alternative. Following this, a one way sensitivity analysis was performed to determine robustness of the best alternative to small changes in weight of different measures (Feng and Keller, 2006; Ferretti et al., 2014). Weights were adjusted on each measure continuously which changes the weights on remaining measures proportionally. If the change to weights within a range of ±10% did not result in a change in ranking of the best alternative, it is considered to be a robust solution (refer Fig. 3.7 and Fig. 3.8).

Results

As discussed in section "Introduction", PDS is affected by various inefficiencies therefore the overarching objective of the government initiative was to improve the overall performance of the system. So the overall objective of the decision problem was to maximize the PDS performance by a relevant policy intervention such as six monthly distribution system. Authors identified eight fundamental objectives as: 1) maximize beneficiary convenience – the definitive stakeholder for PDS are the beneficiaries and their convenience of engaging with the system is an important fundamental objective

which includes accessibility of the system to all the members of the family including

females, affordable cost of engagement, convenient distance of grain distribution centers

from beneficiary's residence, minimum involvement with the system, and ease of grain

handling; 2) maximize beneficiary empowerment – it is necessary that the PDS system

empowers beneficiaries by providing them proper and timely information about

distribution of grains, about redressal mechanism and their rights so that they are not

exploited by middlemen; 3) maximize delivery efficiency –Bajaj, (2012) reports majority

of the PDS losses are reported after state government procures grain from the federal

warehouses and during distribution of grains. In order improve the performance of PDS it

is important to improve delivery efficiency of the system by providing maximum

supervision, on-time delivery and reducing logistical complexity of the supply chain; 4)

maximize quality of grains – the grains supplied to beneficiary should be of superior

quality without any adulterations, infestation and should have proper moisture content so

that they can be stored longer; 5) maximize quantity of grains – the quantity of grains

supplied to beneficiaries should be sufficient for the household to meet the daily

requirements and should be equivalent to their entitlement; 6) maximize technology

adoption – over the years the adoption of technology has reduced corruption and leakages

to a larger extent so maximum computerization of PDS database is an important

objective; 7) minimize corruption – the state loses about 60% of the total grains to

corrupt practices such as exclusion and inclusion errors, leakages, exploitation by

middlemen and weighing malpractices which need to be controlled to improve the overall

performance of PDS; and 8) minimize state expenditure – the state uses tax payers money

to subsidize the grains for the beneficiaries so they are liable to use it judiciously hence

minimizing expenditure is an important criteria. Authors included 22 sub-objectives and 24 non-redundant measures in the objectives hierarchy as in Fig 3.2.

The IDEF0 diagram illustrated three critical functions of PDS as procure, store and distribute grains. The system starts with the input from the farmers in the form of grains. The PDS system works under various guidelines of the state and federal government and the important output of the system are farmer's income in the form of minimum support price (MSP), creation of a national buffer stock for emergency situation such as drought, export stock for deficient states and most importantly food security for below poverty line citizens of the country (refer Fig. 3.3) (Balani, 2013). This IDEF0 diagram illustrates functional analysis of the wheat supply chain[1] only.

Swing weights assessment is shown in Table 3.4. Since the main objective of PDS is to increase food security of beneficiaries so the improvement of "quantity", "quality" of grains distributed to the beneficiaries received a high rank and highest weight. They are all the basic necessities for any food aid program to succeed (Riely et al., 1999). It was also observed that once the system is resilient enough to provide optimum quality and quantity of grains the second most important thing is the cost at which the grains are available to the beneficiaries (Riely et al., 1999). An increased cost can severely impact the beneficiaries' decision to participate in PDS. The demographic profiles of beneficiaries suggest that all were below poverty line (BPL) with annual incomes less than USD 896. Saving state expenditure on grain distribution was also significantly important objective and hence the measure was weighted accordingly (Puri, 2014). Convenience factors of beneficiaries such as frequency of visits to fair price shops,

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[1] Although black grams (pulses) are an integral part of new atta-daal (wheat-pulses) scheme but there is no explicit mention of same in the provisions, therefore authors focus on wheat supply chain only

female accessibility, distance of PDS outlet, and storage perception were important but not as critical so were ranked lower than others. Other measures were ranked accordingly (refer Table 3.4). These rankings were verified and validated with field experts. Authors identified the following six alternatives as discussed in section "Identifying different alternatives":

1. *One monthly distribution system (old system)*: As described in section "Introduction", prior to 2014 the grains were being distributed to the beneficiaries on a monthly basis. The beneficiaries use to go to the FPS with their ration cards on a monthly basis and procure their grains (Puri, 2014). So one of the alternatives was to revert to the original set of distribution system. With monthly system the PDS becomes more accessible to females as they face lesser logistical challenges compared to handling bulk quantity of grains in six monthly system (Grover & Chopra, 2017).

2. *Six monthly distribution system (status quo):* The state government in 2014 introduced the new wheat-pulses scheme where they distribute grains on a six monthly basis (Dept. of Food Civil Supplies & Consumer Affairs, 2014). Refer Table 3.1 for details on the new set of regulations. With these new set of regulations the government wanted to control state expenditure on transportation, storage and preservation of grains as now the grains will be handled twice a year rather than 12 times as compared to the monthly system (Puri, 2014).

3. *Quarterly distribution of grains with new set of regulations:* This is a hypothetical situation in which the distribution frequency was assumed to be three months instead of six months. New rules of wheat pulses scheme were incorporated as described in Table 3.1. The quarterly system can help reduce frequency of grain distribution

thereby optimizing beneficiary convenience of going to the FPS often as in a monthly

system and at the same time also help the state reduce logistical cost.

4. *Yearly distribution of grains with new set of regulations:* This is a hypothetical

    situation in which the distribution frequency was assumed to be twelve months

    instead of six months but with new set rules as described in Table 3.1. This will

    further reduce state expenditure but will increase the cost of storage and preservation

    for the beneficiaries.

5. *One monthly distribution system with new set of regulations:* This is also a

    hypothetical situation in which the old one monthly distribution system is assumed to

    be modified with new set of regulations as described in Table 3.1 except the

    distribution frequency of six months. This will help beneficiaries reduce storage cost

    of grains.

6. *Improved six monthly distribution system:* Beneficiaries suggested to make

    improvements in the existing six monthly distribution system by improving on-time

    delivery of grains by setting a predetermined date, improving communication

    network for information regarding grain arrival and making six monthly system

    optional so that beneficiaries could revert back to old one monthly system as required

    (Gaikwad, 2010).
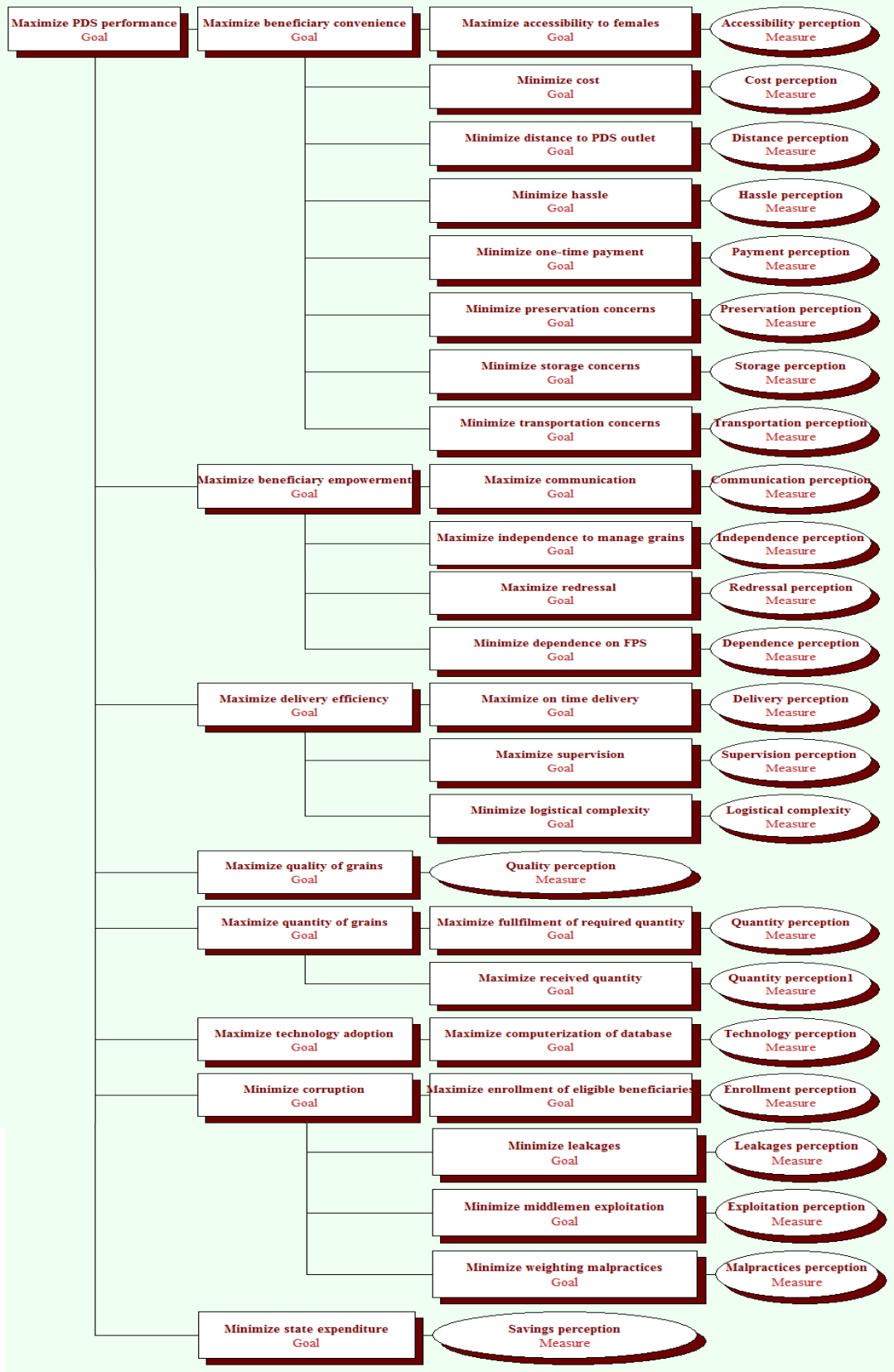
Figure 3.2. Objectives hierarchy for Public Distribution System decision problem

Data was collected and scaled up for each measure against all the identified

alternatives as discussed in section "Survey design and data collection". Refer Table 3.5

and Table 3.6 for response scale of two measures i.e. accessibility and cost perception.

Other measures were scaled similarly. Table 3.7 presents scaled up responses for all

measures against all the six alternatives. This is the performance of each alternative

against each measure along with the SUF scores developed as discussed in section

"Developing single measure utility functions".

Figure 3.3. Integrated definition for function modeling (IDEF0) Level 1 for a formal

modeling of PDS supply chain

Table 3.4. Relative ranking of all the measures and swing weights

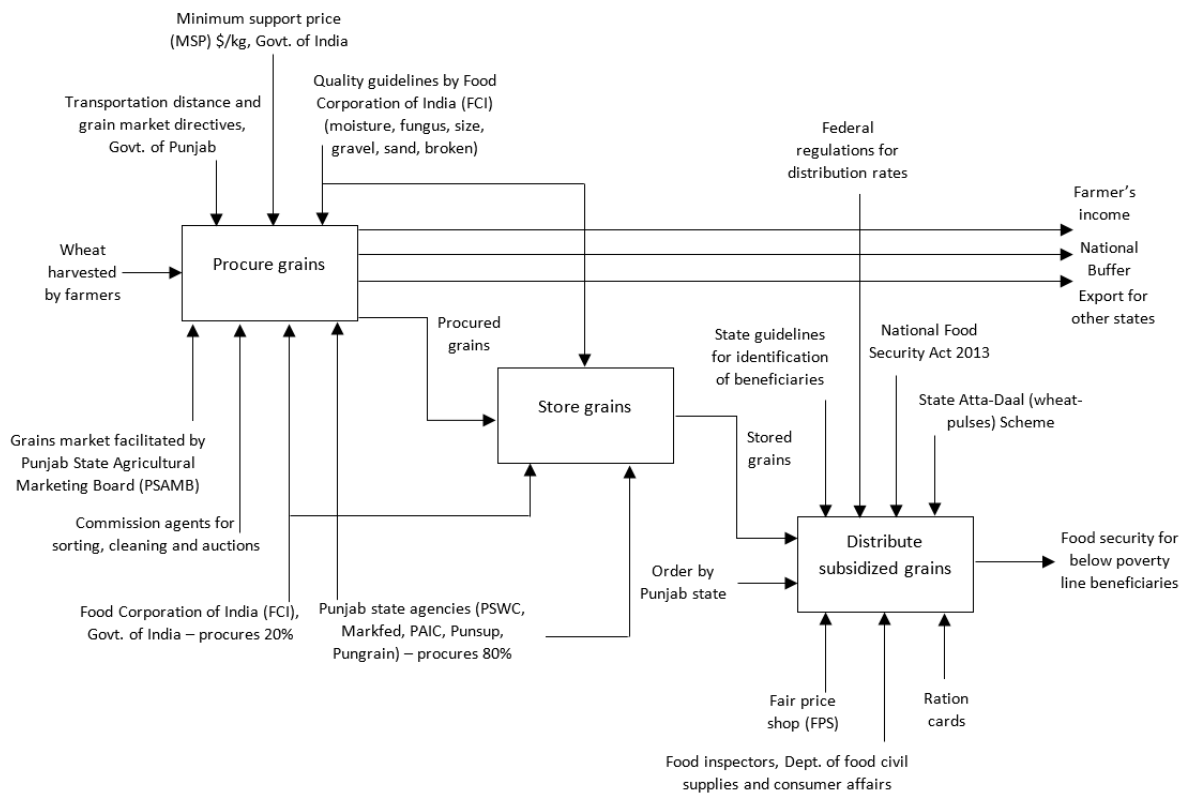| Measure	Definition[a]	Rank order	Points	Final weights
Accessibility perception (females)	Perception of beneficiaries regarding female participation (i.e. purchasing, transporting, completing transactions) in PDS	10	70	0.0422
Cost perception	Perception of beneficiaries regarding cost (i.e. purchasing, transporting, storage of grains) of engagement with the PDS	4	95	0.0572
Distance perception	Perception of beneficiaries regarding distance of PDS outlet from their house	10	70	0.0422
Hassle perception	Perception of beneficiaries regarding botheration i.e. FPS visiting frequency	10	70	0.0422
Payment perception	Perception of beneficiaries regarding inconvenience caused due to onetime payment	4	90	0.0542
Preservation perception	Perception of beneficiaries regarding inconvenience caused due to preservation of bulk grains	15	60	0.0361
Storage perception	Perception of beneficiaries regarding inconvenience caused due to storage of bulk grains	10	70	0.0422
Transportation perception	Perception of beneficiaries regarding inconvenience caused due to transportation of bulk grains	18	55	0.0331
Communication perception	Perception of beneficiaries regarding communication of arrival of grains	15	60	0.0361
Independence perception	Perception of beneficiaries regarding independence to manage their own grain	18	50	0.0301
Redressal perception	Perception of beneficiaries regarding system of redressal	17	55	0.0331
Dependence perception	Perception of beneficiaries regarding dependence on FPS representatives	18	50	0.0301
Delivery perception	Perception of beneficiaries regarding on-time delivery of grains	10	70	0.0422
Supervision perception	Perception of beneficiaries regarding supervision of government over PDS	18	40	0.0241

Table 3.4. Continued

Logistical complexity perception	Perception of beneficiaries regarding logistical complexity of public distribution supply chain	18	50	0.0301
Quality perception	Perception of beneficiaries regarding quality (adulteration, infestation etc.) of grains	1[b]	100	0.0602
Quantity perception	Perception of beneficiaries regarding fulfillment of required grain quantity	1[b]	100	0.0602
Quantity perception 1	Perception of beneficiaries regarding receiving entitled grain quantity	1[b]	100	0.0602
Technology perception	Perception of beneficiaries regarding technology adoption by government	23[a]	40	0.0241
Beneficiary enrollment perception	Perception of beneficiaries regarding enrollment of new eligible beneficiaries	9	75	0.0452
Leakages perception	Perception of beneficiaries regarding leakages in the PDS system	7	80	0.0482
Exploitation perception	Perception of beneficiaries regarding exploitation by middlemen	23[b]	40	0.0241
Weighing malpractices perception	Perception of beneficiaries regarding malpractices during weighing of grain bags	7	80	0.0482
State savings perception	Perception of beneficiaries regarding state expenditure	4	90	0.0542
		Total	1660	1.00[c]

[a] Perception of all these measures were measured using a seven point Likert scale

[b] Rank 1 denotes high relative importance of the measure as compared to other measures and rank of 23 denotes low importance

[c] Weights have been rounded off to four decimal places so the sum might not be exactly equal to one

Table 3.5. Accessibility perception of beneficiaries regarding females as measured on a seven point Likert scale[1]

Score	Levels	Preference	Description
0	No/Low	Least preferred	Average Likert scale score of 300 beneficiary household is less than equal to -1 which indicates that the perception of beneficiaries regarding female participation (i.e. purchasing, transporting, completing transactions) in PDS is low
5	Medium		Average Likert scale score of 300 beneficiary household is between -1 to +1 which indicates that the perception of beneficiaries regarding female participation (i.e. purchasing, transporting, completing transactions) in PDS is neither high nor low
10	High	Most preferred	Average Likert scale score of 300 beneficiary household is more than equal to 1 which indicates that the perception of beneficiaries regarding female participation (i.e. purchasing, transporting, completing transactions) in PDS is high

Table 3.6. Cost perception of beneficiaries measured on a seven point Likert scale

Score	Levels	Preference	Description
10	No/Low	Most preferred	Average Likert scale score of 300 beneficiary household is less than equal to -1 which indicates that the perception of beneficiaries regarding cost (i.e. purchasing, transporting, storage of grains) of PDS is low
5	Medium		Average Likert scale score of 300 beneficiary household is between -1 to +1 which indicates that the perception of beneficiaries regarding cost (i.e. purchasing, transporting, storage of grains) of PDS is neither high nor low
0	High	Least preferred	Average Likert scale score of 300 beneficiary household is more than equal to +1 which indicates that the perception of beneficiaries regarding cost (i.e. purchasing, transporting, storage of grains) of PDS is high

[1] Seven point Likert scale ranges from -3 to +3 where -3 refers to strongly disagree, +3 refers to strongly agree and 0 refers to a neutral response

Table 3.7. Each alternative's performance with respect to measures and single measure

utility functions (SUF)

Measure	One month -old system (SUF)	Six monthly - system status quo (SUF)	Quarterly system - new rules (SUF)	Yearly system - new rules (SUF)	One month - new rules (SUF)	Six monthly - improved (SUF)
Beneficiary enrollment perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)
Communication perception	5 (0.5)	5 (0.5)	5 (0.5)	0 (0)	5 (0.5)	10 (1.0)
Cost perception	5 (0.5)	5 (0.5)	5 (0.5)	10 (1.0)	5 (0.5)	5 (0.5)
Delivery perception	10 (1.0)	5 (0.5)	5 (0.5)	0 (0)	10 (1.0)	10 (1.0)
Dependence perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	5 (0.5)	10 (1.0)
Distance perception	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)
Exploitation perception	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)	0 (0)
Accessibility perception (females)	10 (1.0)	5 (0.5)	5 (0.5)	0 (0)	10 (1.0)	5 (0.5)
Hassle perception	0 (0)	10 (1.0)	5 (0.5)	10 (1.0)	0 (0)	10 (1.0)
Independence perception	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)
Leakages perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)
Logistical complexity perception	5 (0.5)	10 (1.0)	5 (0.5)	10 (1.0)	5 (0.5)	10 (1.0)
Payment perception	10 (1.0)	5 (0.5)	5 (0.5)	0 (0)	10 (1.0)	5 (0.5)
Preservation perception	10 (1.0)	10 (1.0)	10 (1.0)	5 (0.5)	10 (1.0)	10 (1.0)
Quality perception	5 (0.5)	10 (1.0)	5 (0.5)	10 (1.0)	5 (0.5)	10 (1.0)

Table 3.7. Continued

Quantity perception1	0 (0)	10 (1.0)	5 (0.5)	5 (0.5)	5 (0.5)	10 (1.0)
Redressal perception	0 (0)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)
State savings perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)
Storage perception	10 (1.0)	5 (0.5)	5 (0.5)	0 (0)	10 (1.0)	5 (0.5)
Sufficient quantity perception	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)
Supervision perception	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)	5 (0.5)
Technology perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)
Transportation perception	10 (1.0)	5 (0.5)	10 (1.0)	0 (0)	10 (1.0)	5 (0.5)
Weighing malpractices perception	0 (0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)	10 (1.0)

Ranking for Maximize PDS performance Goal

Alternative	Utility
Six monthly (improved)	0.788
Six monthly distribution (existing)	0.748
One month (new rules)	0.723
Quaterly distribution (new rules)	0.669
Yearly distribution (new rules)	0.604
One month (old rules)	0.441

- Maximize beneficiary convenience
- Minimize corruption
- Maximize beneficiary empowerment
- Maximize quantity of grains
- Maximize delivery efficiency
- Maximize quality of grains
- Minimize state expenditure
- Maximize technology adoption

Figure 3.4. Multi-measure utility function for each alternative with respect to

fundamental objectives

Maximize PDS performance Goal Utility for	Six monthly (improved)	0.788
	Six monthly distribution (existing)	0.748
	Total Difference	0.039

	Difference	Six monthly distribution (existing)	Six monthly (improved)
Total Difference	0.039		
delivery perception	0.021		
communication perception	0.018		
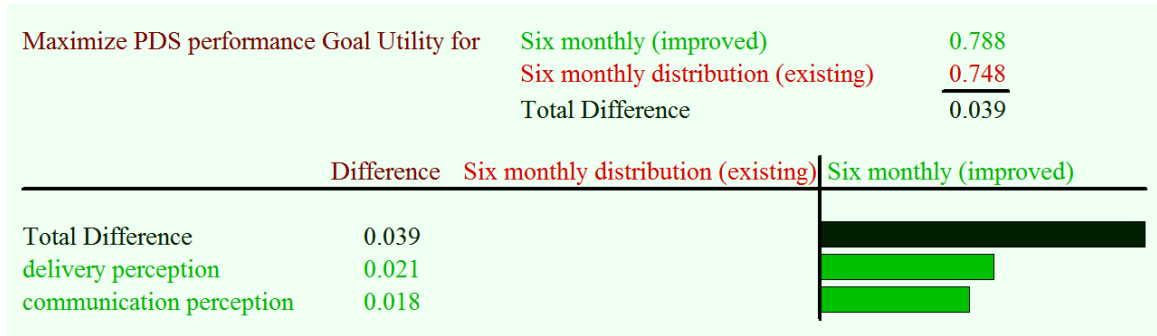
Figure 3.5. Tornado diagram for comparing two best alternative

Maximize PDS performance Goal Utility for	Six monthly (improved)	0.788
	One month (old rules)	0.441
	Total Difference	0.346

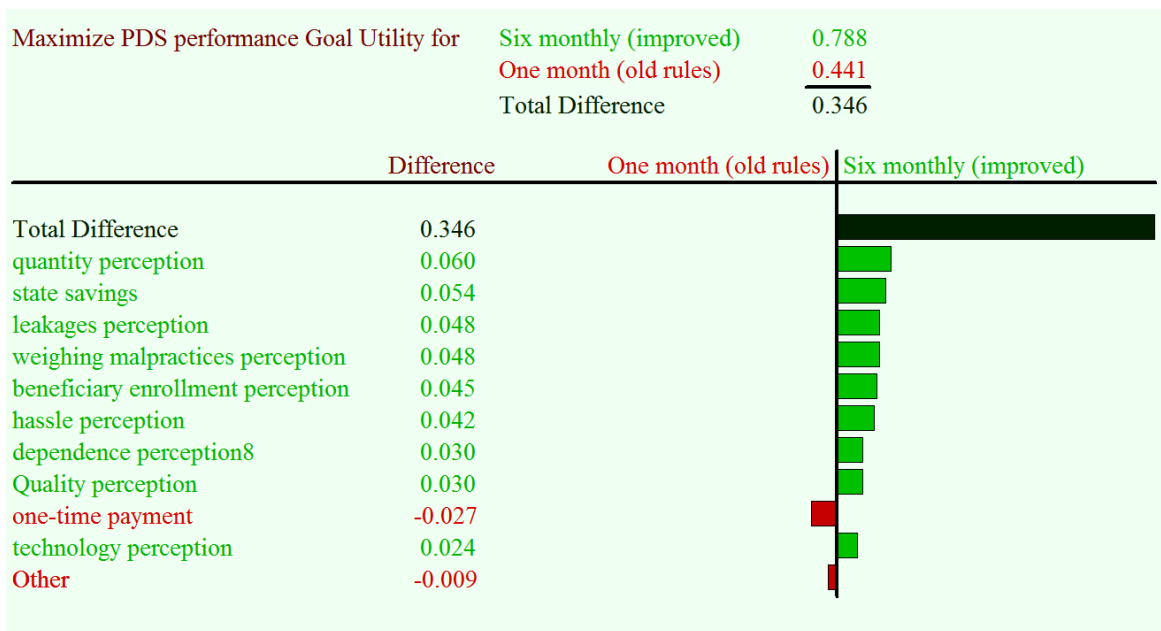|	Difference	One month (old rules)	Six monthly (improved)
Total Difference	0.346		
quantity perception	0.060		
state savings	0.054		
leakages perception	0.048		
weighing malpractices perception	0.048		
beneficiary enrollment perception	0.045		
hassle perception	0.042		
dependence perception8	0.030		
Quality perception	0.030		
one-time payment	-0.027		
technology perception	0.024		
Other	-0.009		

Figure 3.6. Tornado diagram for comparing the best and least preferred alternative

Multi-measure utility functions were developed for each alternative and the scores were plotted as in Fig 3.4. The overall utility for alternative "six monthly system with improvements" has the maximum value followed by the "existing six monthly system (status quo)", "one monthly system with new rules", "quarterly distribution system with new rules", "one monthly system with old rules" and "yearly distribution system with new rules" respectively. The MUF distribution for improved six monthly system has

maximum utility for fundamental objectives of "beneficiary empowerment", and "delivery efficiency" as compared with other alternatives. The old one monthly distribution system under performs both on technology adoption and saving state expenditure. This is because the old system did not have provisions for technology introduction, and had complex logistics involved.

Relative strength of improved six monthly distribution system and existing six monthly distribution system (status quo) was compared with each other and improved six monthly distribution system performed better on delivery and communication perception (refer Fig. 3.5). The improved six monthly system was also compared with the old one monthly distribution system and it performed better on almost every measure except one-time payment perception (refer Fig. 3.6). A one way sensitivity analysis was performed on all the measures for all the alternatives. The solution was found to be robust for all 24 measures as a change to weights within a range of ±10% did not result in a change in ranking of the best alternative (Feng and Keller, 2006). The analysis was carried out using the software *Logical decisions ® v. 7.2*. The sensitivity analysis of these alternatives for communication perception and delivery perception are shown in Fig. 3.7 and Fig. 3.8.
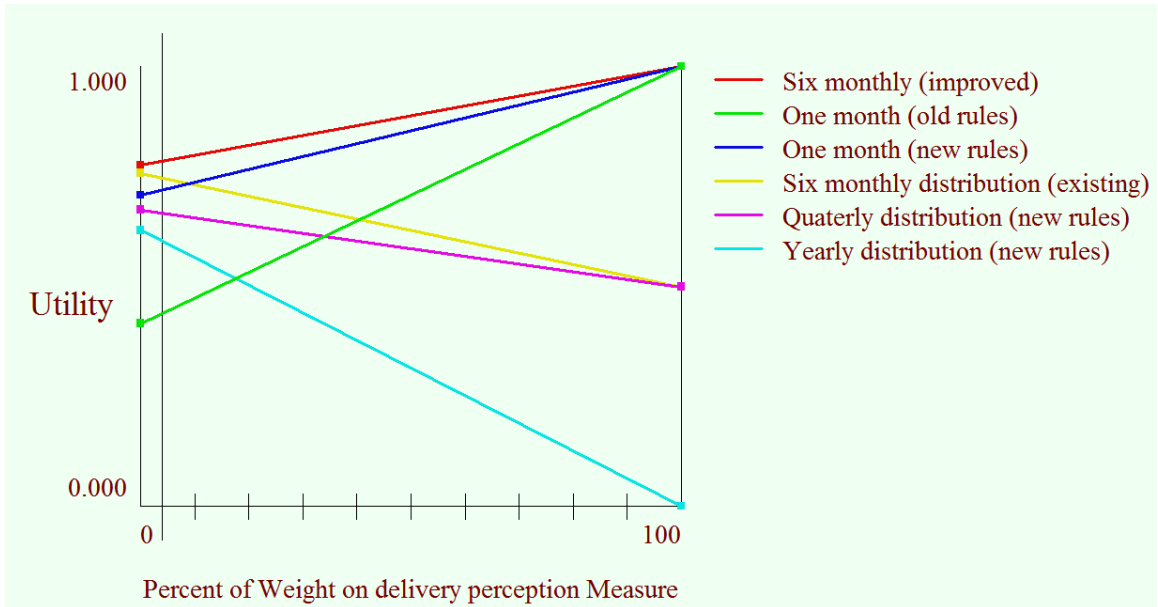
Figure 3.7. One-way sensitivity analysis on percent weight on the "communication perception" measure
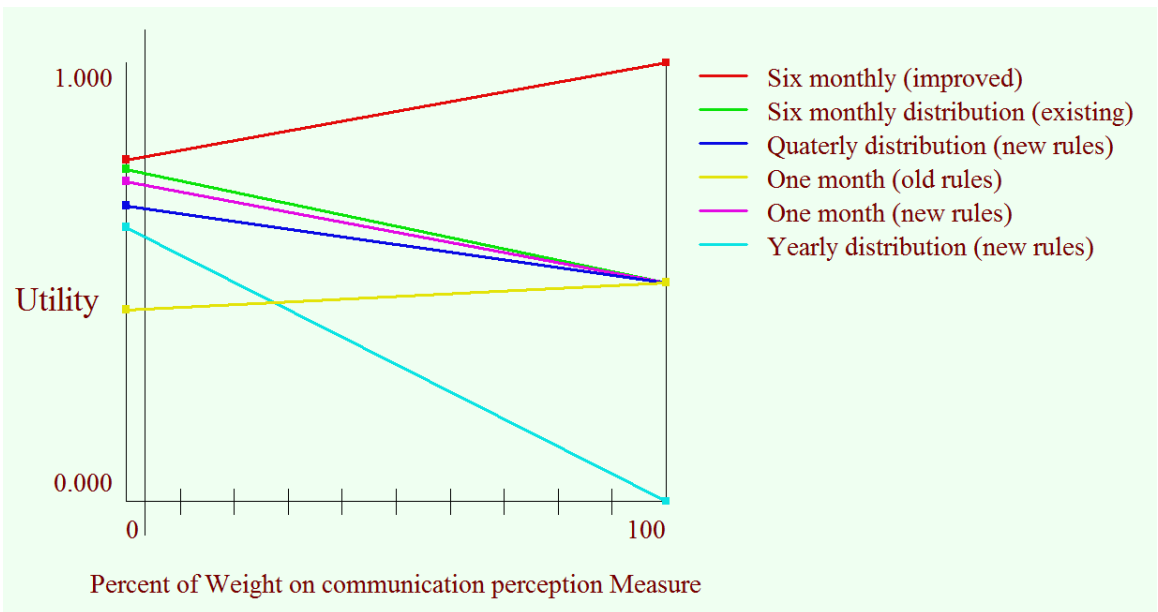

Figure 3.8. One-way sensitivity analysis on percent weight on the "delivery" measure

Discussion

Our findings suggest that "improved six monthly distribution system" is the best solution among all the possible alternatives followed by the "existing six monthly distribution system" (status quo) with respect to beneficiaries' perspective. This is mainly because of beneficiaries' perception regarding decrease in corruption and inefficiencies in the public distribution supply chain with the introduction of improved six monthly distribution system and the existing six monthly distribution system. This finding is consistent with the findings of Fredriksson and Svensson (2003) who concluded that corruption reduces the stringency of the regulations thereby decreasing the effectiveness of the policy. With the new set of regulations of the wheat-pulses scheme beneficiaries expect an increase in government supervision, reduction in the number of middle men, reduction in ghost cards and delivery of sealed grain bags. A decrease in corrupt practices in the supply chain such as black marketing, adulteration and exploitation by middlemen leads to increase in quality, and quantity of grains (Gaikwad, 2010; Kumar, 2015). This in turn increases beneficiaries' trust in the system which is essential for successful policy implementation.

Beneficiaries perceive that they are more empowered with the improved six monthly system as compared to one monthly distribution system. This is because of improved communication from the government regarding grain arrival. Communication is very critical to maintain transparency in the system which further facilitates accountability, and trust. This finding was consistent with the findings of Tierney and Minor (2004) as they suggested that communication plays an important structural role in enabling effective governance. Beneficiaries felt that the new redressal mechanism

introduced with the six monthly system will help reduce their grievances and improve feedback to government. This decentralized feedback mechanism further improved their perception about the new policy's role in their empowerment. The other provision of reducing beneficiaries' dependence on FPS and providing them with more independence to manage their grains also had a positive impact on beneficiaries' perception. Reduced dependence on middle-men for grain procurement will not only improve supply chain efficiency but also increase direct communication between beneficiaries and the government (Khanna & Johnston, 2007). With the new policy of door step delivery the distribution of grains happen at common sites such as local temples or play grounds. So instead of interacting on an individual basis with FPS representatives' beneficiaries receive grains in front of other beneficiaries under direct supervision of food inspectors.

The findings also indicate that beneficiaries perceive that with six monthly distribution system the quantity and quality of grains distributed will be better as compared to the other alternatives. Quantity and the quality are the two very critical factors affecting beneficiaries' perception and these findings are consistent with the findings of Kumar (2015), Ramaswami and Balakrishnan (2002). Quantity is directly linked with corruption and delivery mechanism. Since regulations allow for distribution of sealed bags of 30 kg each, this decreases malpractices related to leakages. Furthermore in the new system the grains are distributed directly after grain procurement thereby reducing the storage time at the state depots guaranteeing fresh grains to the beneficiaries.

Beneficiaries' perception regarding state expenditure more or less remains same for all the alternatives except the old one monthly distribution system. They perceive that with new regulations leakages will decrease which will eventually help save the state

more than logistical changes of six monthly distribution. Authors believe that it will be really difficult to estimate state savings with the existing leakages. So the government will have to prioritize their policy intervention by first controlling leakages and decreasing other corrupt practices. Any logistic changes such as distribution frequency can follow thereafter. Technology adoption is one such way to control leakages by computerization of transactions, digitization of supply chain and improving beneficiary identification (Rajan et al., 2016).

Findings also suggest that beneficiary perceive that their convenience is actually decreased with the "improved six monthly" distribution system because the system is less accessible to females, one-time payment is high as compared to monthly transactions and grain handling becomes a challenge (Gaikwad, 2010). But despite of these challenges the overall utility for six monthly system is more because of critical advantages such as improved quality and quantity of grains.

So beneficiaries' perception regarding these eight fundamental objectives helps them rank all the alternatives and choose the best among them. Authors discussed how these fundamental objectives are critical decision making parameter and how do they affect alternative ranking from beneficiaries' perspective. MCDA technique played a very critical role in understanding the beneficiaries' perspective. It systematically helped to break down this complex macro scale problem into measureable sub-objectives which actually formulate the essence of this food policy. This was consistent with the findings of Feng and Keller (2006), Gregory et al., (2005), and Walker (2000). The objectives hierarchy was critical to identify the important matrices which realistically measure the performance of the policy which otherwise was not possible. The overall objective

constituted of eight fundamental objectives and 22 sub objectives which established the basic requirements and expectations of the stakeholders from public distribution system which otherwise would have been difficult. We were not only able to identify several critical sub objectives but even prioritize them with the weights. With established requirements it was easy to evaluate alternatives. Food policy formulation and analysis has its own sets of challenges for developing countries because of population, diversity, and illiteracy. These factors make policy analysis very difficult and uncertain. Availability of food is the basic requirement of every human being to survive and food policies are critical in achieving this. Any wrong policy decision can jeopardize the lives of many underprivileged citizens of the country. Authors find that capturing the basic requirements of diverse beneficiaries' and interests of other stakeholders is not possible without systematic techniques such as MCDA. This technique allows including uncertainty, non-linear utility functions and sensitivity analysis which not only allows for realistic modelling but also helps establishing the robustness of the solution. Therefore authors definitely found that with given framework of decision analysis, MCDA facilitated complex decision making during policy formulation and analysis with respect to food distribution in developing countries and should be used in more such studies (Gregory et al., 2005; Walker, 2000). Such structured techniques have been useful for various policy makers as discussed in section "Introduction". Given the critical nature of food policies a systematic and accountable decision making is need of the hour. Hopefully such techniques can be leveraged more for decision analysis processes to improve the reach and sustainability of existing policies.

Study limitations and future work

There are several limitations of the study and first being that only beneficiaries' perspective is used to evaluate the performance of all alternatives. Furthermore the data collected from the beneficiaries were collected using purposive snowball sampling which affects the generalization of the results. The data was collected only in one district of Punjab i.e. Ludhiana which further limits the generalizability of the results. The Likert scale data was scaled to a range of zero to ten. Though this was appropriate given the complexity of problem at hand but a use of Likert scale data to develop SUF could have been more precise. The utility functions developed were all linear because of the inherent linearity due to Likert scale. Authors could have used a different scale to establish non linearity for different measures to represent realistic situation. Though MAUT allows for integration of uncertainty but given the complexity of decision problem authors did not include uncertainty values. During survey data collection in Aug'16 the state of Punjab was nine months away from state assembly elections. The election season made it difficult to capture uncertainty. Furthermore authors used hypothetical situations for a few alternatives, which the beneficiaries have not experienced before. Authors collected data for "old one monthly distribution system" and the "existing six monthly distribution system" and extrapolated responses for other alternatives based on the survey data. Authors also use constructed scale measures for some natural scale measures such as state expenditure values due to limitations of primary data. It was assumed that multi-measures utility functions will have mutually independent constructs and hence an additive function was used instead of multiplicative function.

Future work definitely includes enhancing the sample size and geographic representation of data. Authors would like to collect data from all the stakeholders regarding their perception of alternatives in near future to compare the results. Authors would like to use other MCDA techniques such as AHP to do a comparison analysis for MAUT and establish advantages of one over the other.

Conclusions

The research findings suggest five different alternatives for the "six monthly distribution system" but conclude that an improved version of six monthly distribution system with better communication channel and disciplined distribution of grains is the best solution among these alternatives. The beneficiaries perceive that the status quo i.e. existing six monthly distribution system is actually a good solution if implemented effectively. Further MCDA technique has been demonstrated to facilitate complex decision making during policy formulation and analysis with respect to food distribution in developing countries. A general framework adopted in this study for MCDA can be used for future policy analysis by including contextual variations. Given the constraints of population, diversity, and illiteracy in developing countries such as India, MCDA can systematically incorporate several opinions to yield a solution that can have better acceptability among stakeholders which can further contribute to the successful food policy implementation. This in turn contributes to improve the food security of developing nations.

References

Almeida, C., & Bascolo, E. (2006). Use of research results in policy decision-making, formulation, and implementation: a review of the literature. *Cad Saude Publica, 22*(19), 7 – 19.

Bajaj, V. (2012, June 7). As grain piles up, India's poor still go hungry. *The New York Times.* Retrieved from http://www.nytimes.com/2012/06/08/business/global/a-failed-food-system-in-india-prompts-an-intense-review.html?_r=1&smid=FB-nytimes&WT.mc_id=BU-E-FB-SM-LIN-AGP-060812-NYT-NA&WT.mc_ev=click

Balani, S. (2013). Functioning of the Public Distribution System, an analytical report. *PRS Legislative Research*. Retrieved from http://www.prsindia.org/administrator/uploads/general/1388728622~~TPDS%20Thematic%20Note.pdf

Chien, C., & Sainfort, F. (1998). Evaluating the desirability of meals: An illustrative multi-attribute decision analysis procedure to assess portfolios with interdependent items. *Journal of Multi-Criteria Decision Analysis, 7*, 230 – 238.

Chopra, S. (2014). *Topics in food security: measuring performance and technology adoption in the public distribution system supply chain of Chhattisgarh, India* (Doctoral dissertation). Retrieved from Purdue library. (AAI3668781)

Creswell, J. W. (2013). *Research design: Qualitative, quantitative, and mixed methods approaches*. Sage.

Daviter, F. (2013). An information processing perspective on decision making in the European Union. *Public Administration, 92*(2), 324 -339.

Dept. of food civil supplies & consumer affairs, Government of Punjab. (2014). *New Atta Dal Scheme*. Retrieved from http://foodsuppb.nic.in/newattadal.html

Dyer, S. J. (2005). *Multiple criteria decision analysis: State of the art surveys*. New York City, NY: Springer

Economic & statistical organization. (2013). *Statistical Abstract of Punjab*. Chandigarh, Punjab: Government of Punjab.

FAO. (2015). *The state of food insecurity in the world*. Retrieved from http://www.fao.org/3/a-i4646e.pdf

Feng, T., & Keller, R. L. (2006). A multiple-objective decision analysis for terrorism protection: Potassium iodide distribution in nuclear incidents. *Decision Analysis, 3*(2), 76 – 93.

Ferretti, V., Bottero, M., & Mondini, G. (2014). Decision making and cultural heritage: An application of the multi-attribute value theory for the reuse of historical buildings. *Journal of Cultural and Heritage, 15*, 644 – 655.

Fredriksson, P. G., & Svensson, J. (2003). Political instability, corruption and policy formation: The case of environmental policy. *Journal of Public Economics, 87*(7), 1383 – 1405.

Gaikwad, S. (2010). Scheme for home delivery of food grains – a successful experiment under public distribution system. *Yashwantrao Chavan Academy of Development Administration*, *Best Practice Series One.* Retrieved from http://sheetalkachare.ucoz.com/Scheme_for_Home_Delivery_of_Foodgrains.pdf

Gregory, R., Fischhoff, B., & McDaniels, T. (2005). Acceptable input: Using decision analysis to guide public policy deliberations. *Decision Analysis, 2*(1), 4 – 16.

Grover, A. K., & Chopra, S. (2017). Factors affecting beneficiaries' preference for six-monthly distribution of food grains in Indian Punjab: A step towards decentralized policy making in public distribution system *(Unpublished research paper).* Under review

Grover, A. K., Chopra, S., & Mosher, G. A. (2016). Food safety modernization act: A quality management approach to identify and prioritize factors affecting adoption of preventive controls among small food facilities. *Food Control, 66*, 241 – 249.

Jain, S. P., & Polman, W. (2003). A handbook for trainers on participatory local development -The panchayati raj model in India. *Food and Agriculture Organization*. Retrieved from ftp://ftp.fao.org/docrep/fao/006/ad346e/ad346e00.pdf

Keeney, R. L. & Raiffa, H. (1976). *Decision with multiple objectives*. New York City, NY: Wiley & Sons.

Khanna, J., & Johnston, M. (2007). India's middlemen: Connecting by corrupting? Crime, Law and Social Change, 48(151).

Khera, R. (2014). Cash vs. in-kind transfers: Indian data meets theory. *Food Policy, 46*(14), 116 – 128.

Kim, S. H. & Jang, K. J. (2002). Designing performance analysis and IDEF0 for enterprise modelling in BPR. *.International Journal of Production Economics, 96*(1), 47 – 62.

Kishore, A., & Chakrabarti, S. (2015). Is more inclusive more effective? The 'New Style' public distribution system in India. *Food Policy, 55*, 117 – 130.

Kumar, S. (2015). Report of the high level committee on re-orienting the role and restructuring of Food Corporation of India. Government of India. Retrieved from http://www.fci.gov.in/app2/webroot/upload/News/Report%20of%20the%20High %20Level%20Committee%20on%20Reorienting%20the%20Role%20and%20Re structuring%20of%20FCI_English_1.pdf

Mitchell, K. R., & Agle, B. R., & Wood, D. J. (1997). Towards a theory of stakeholder identification and salience: Defining the principle of who and what really counts. Academy of management review, 22(4), 853 – 886.

Neuendorf, K. A. (2002). The Content Analysis Guidebook. Thousand Oak, CA: Sage.

Puri, A. (2014, May 2). A grain of sense – how Punjab is making the best use of the flawed public distribution system. *The Indian Express*. Retrieved from http://indianexpress.com/article/opinion/columns/a-grain-of-sense/

Rajan, P., Chopra, S., Somasekhar, A. K., & Laux, C. (2016). Designing for food security: portability and the expansion of user freedoms through the COREPDS in Chhattisgarh, India. *Information Technologies and International Development, 12*(3), 1 – 18.

Ramaswami, B., & Balakrishnan, P. (2002). Food prices and the efficiency of public intervention: the case of the public distribution system in India. *Food Policy, 27*(5), 419 – 436.

Riely, F., Mock, N., Cogill, B., Bailey, L., & Kenefick, E. (1999). Food security indicators and framework for use in the monitoring and evaluation of food aid programs. Food and Nutrition Technical Assistance, 1 – 50.

Saaty, T. L. & Zoffer, H. J. (2012). A new approach to the Middle East conflict: The analytic hierarchy process. *Journal of Multi-Criteria Decision Analysis, 19*, 201 – 225.

Sanayei, A., Mousavi, F. S., & Abdi, M. R., & Mohaghar, A. (2008). An integrated group decision-making process for supplier selection and order allocation using multi-attribute utility theory and linear programming. *Journal of the Franklin Institute, 345*(7), 731 – 747.

Stebbins, R. A. (2001). *Exploratory Research in Social Sciences*. Thousand Oaks, CA: Sage Publications.

Tierney, W. G., & Minor, J. T. (2004). A cultural perspective on communication and governance. New Directions for Higher Education, 127, 85 – 94.

Walker, W. E. (2000). Policy analysis: A systematic approach to supporting policymaking in the public sector. *Journal of Multi-Criteria Decision Analysis, 9*, 11 – 27.

Wei, C., Chein, C., & Wang, M. J. (2005). An AHP –based approach to ERP system selection. *International Journal of Production Economics, 96*(1), 47 – 62.

CHAPTER 4. SUMMARY AND CONCLUSIONS

Summary

Authors analyzed the six monthly distribution system of food grains from beneficiaries' perspective. A deep insight into public distribution system of Punjab is presented in the paper. Authors use primary data of exploratory research and survey to inform the research objectives. In the first research paper authors identified several impeding, facilitating and demographic factors affecting beneficiaries' preference for six monthly distribution of food grains in the PDS of Punjab, India using logistic regression modelling. These factors included "monthly hassle", "perception of leakages in system", "storage challenges", "interval of grain distribution", "one-time down payment", "trade of bulk grains by family", "exploitation by middle-men", "communication of arrival of grains", "gender", "area" (rural/urban) and "nature of employment". A deeper understanding of these factors helped authors make policy suggestions to the policy makers.

In the second research authors identified several alternatives to six monthly distribution system and thoroughly investigated their relative strengths and weaknesses. Using MAUT authors identified the best solution among the given alternatives. Five feasible "alternatives" for six monthly interval of grain distribution (status quo) as identified from the research study were quarterly distribution, annual distribution, the old one monthly system, a one monthly system with new regulations and an improved six monthly distribution system. The improved six monthly system was identified as the best solution among given alternatives.

Conclusions

Overall the research work indicates that six monthly distribution system in the Ludhiana district of Punjab is an improvement over the existing one monthly distribution system and will eventually help better the efficiency of the public distribution system in the state if implemented diligently. As reflected through the research study, six monthly distribution system not only decreases the malpractices but it actually improves the quality of grains distributed. It has the potential to provide significant financial savings if implemented effectively. Further research is required to generalize the results.

Beneficiaries play a very significant role in successful implementation of such policies and their buy-in is very critical. Their role in the public distribution supply chain should not be underestimated and their perspective needs to be considered more often than usual. There are several factors that affect their decision of preferring one policy over the other and policy maker need a better understanding of those factors. Our study suggests that factors such as "monthly hassle" which significantly affect beneficiaries' preference should be addressed appropriately. Beneficiaries' indicate their preference for the six monthly system but suggest several improvements to the system such as better communication channel and disciplined distribution of grains.

Furthermore, food policy analysis requires use of more structured and systematic evaluation techniques such as MAUT and logistic regression modeling. These techniques should be incorporated throughout the policy lifecycle i.e. inception, formulation, and implementation. Such analysis does not necessarily provide explicit solutions but the process facilitates the analysts to critically weigh and prioritize the available information to make more informed decisions.

APPENDIX. INSTITUTIONAL REVIEW BOARD (IRB) APPROVAL

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OF SCIENCE AND TECHNOLOGY

Institutional Review Board
Office for Responsible Research
Vice President for Research
1138 Pearson Hall
Ames, Iowa 50011-2207
515 294-4566
FAX 515 294-4267

Date: 9/22/2015

To: Dr. Shweta Chopra **CC:** Abhay Grover
4344 Elings Hall   4324 Elings Hall

From: Office for Responsible Research

Title: Technical Leadership for Food Security: An Empirical Study of the Indian Rice Value Chain and Public Distribution System - Punjab vs. Chhatisgarh

IRB ID: 15-321

Approval Date:	9/22/2015	**Date for Continuing Review:**	9/14/2017
Submission Type:	New	**Review Type:**	Full Committee

The project referenced above has received approval from the Institutional Review Board (IRB) at Iowa State University according to the dates shown above. Please refer to the IRB ID number shown above in all correspondence regarding this study.

To ensure compliance with federal regulations (45 CFR 46 & 21 CFR 56), please be sure to:

- **Use only the approved study materials** in your research, **including the recruitment materials and informed consent documents that have the IRB approval stamp.**

- **Retain signed informed consent documents for 3 years after the close of the study**, when documented consent is required.

- **Obtain IRB approval prior to implementing <u>any</u> changes** to the study by submitting a Modification Form for Non-Exempt Research or Amendment for Personnel Changes form, as necessary.

- **Immediately inform the IRB of** (1) **all serious and/or unexpected adverse experiences** involving risks to subjects or others; and (2) **any other unanticipated problems involving risks** to subjects or others.

- **Stop all research activity if IRB approval lapses,** unless continuation is necessary to prevent harm to research participants. Research activity can resume once IRB approval is reestablished.

- **Complete a new continuing review form** at least three to four weeks prior to the **date for continuing review** as noted above to provide sufficient time for the IRB to review and approve continuation of the study. We will send a courtesy reminder as this date approaches.

Please be aware that IRB approval means that you have met the requirements of federal regulations and ISU policies governing human subjects research. **Approval from other entities may also be needed.** For example, access to data from private records (e.g. student, medical, or employment records, etc.) that are protected by FERPA, HIPAA, or other confidentiality policies requires permission from the holders of those records. Similarly, for research conducted in institutions other than ISU (e.g., schools, other colleges or universities, medical facilities, companies, etc.), investigators must obtain permission from the institution(s) as required by their policies. **IRB approval in no way implies or guarantees that permission from these other entities will be granted.**

Upon completion of the project, please submit a Project Closure Form to the Office for Responsible Research, 1138 Pearson Hall, to officially close the project.